File No. ______
Ref. No. ER 77-177

City of Oakland
Oakland, California

DRAFT ENVIRONMENTAL IMPACT REPORT FOR:
Relocation of Shell Products Pipeline
(Project name)
California Environmental Quality Act (CEQA)

SUMMARY

A. GENERAL INFORMATION

Project Title: Relocation of Shell Products Pipeline

Location: Vicinity of Warren Freeway and Lincoln Avenue

Project Sponsor: Shell Oil Company

Address: P.O. Box 4848 - Anaheim, California 92803

B. PROJECT DESCRIPTION:

Relocation of approximately 9600 ft. of 10 in. diameter pipeline along and across street right-of-ways in a residential neighborhood. The relocation would allow the transport of petroleum products through this area to resume.

C. SUMMARY OF ENVIRONMENTAL CONSEQUENCES OF THE PROJECT:

Under normal circumstances, there would be only minimal, short-term environmental impacts (associated with transient construction activities). However, in the event of certain unpredictable, unlikely, but plausible events (e.g., major earthquake, massive landslide, unplanned excavation) there could be a breakage or rupture of the pipe which could result in product spillage and attendant safety hazards.

D. POSSIBLE MITIGATION MEASURES TO MINIMIZE ANY ADVERSE EFFECTS OF THE PROJECT:

The pipe is proposed to be relocated from its present route to reduce the likelihood of damage from earthquakes or landslides.

It would be installed inside a casing having an interior several times the size of the pipe and designed to allow considerable ground movement before the pipe is stressed at all. The casing would be buried at least 3 ft. below ground, would be run down public streets, and would be shown on the maps the Department of Public Works reviews prior to issuing excavation permits. The Fire Department and Shell Oil Company both have contingency plans for dealing with possible spills.

E. AGENCIES, ORGANIZATIONS AND INDIVIDUALS CONSULTED:

City of Oakland (Fire Dept., Dept. of Public Works, Planning Dept.)
A.C. Transit
Shell Oil Company
Bechtel Corp.
Offshore Development Engineering

F. PUBLIC AGENCIES HAVING JURISDICTION BY LAW OVER THE PROJECT:

City of Oakland

G. PRELIMINARY DRAFT EIR PREPARED BY:

Woodward-Clyde Consultants

DATE COMPLETED:

November 1977

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PART A

ENVIRONMENTAL IMPACT OF CONSTRUCTION AND OPERATION OF PROPOSED PIPELINE

Section I

INTRODUCTION

The proposed project is located in the East Bay Hills. This document describes the environmental impacts expected to occur as a result of constructing and operating a petroleum products pipeline which is proposed to be relocated through a suburban neighborhood in the foothills of Oakland, California. Over the past several years, this pipeline and various plans for its relocation have been matters of considerable public interest and discussion. Because various types of misconceptions stemming from previous proposals could bias public attitude and impair the decision-making process, this Environmental Impact Report presents information on current conditions and proposed plans within the context of the historical setting.

The proposed project is located in the city of Oakland in an area known as the Berkeley Hills. On a broader scale, it is located in the East Bay hills of the San Francisco Bay Area of north-central California. Figure 1 shows Shell Oil Company's Bay Area Products Pipeline in its entirety, and Figure 2 locates the project within the city of Oakland.

The existing pipeline was installed in 1965 and was in continuous operation until 1970. In the winter of 1969-70, repeated land slippage in the vicinity of London Road threatened to damage the pipeline. In January 1970 the line was purged of product and packed with water to prevent a petroleum products spill. With continuing land slippage, the pipeline later broke and has been out of service since January 1970. Alternative actions and routes have been studied and discussed over a

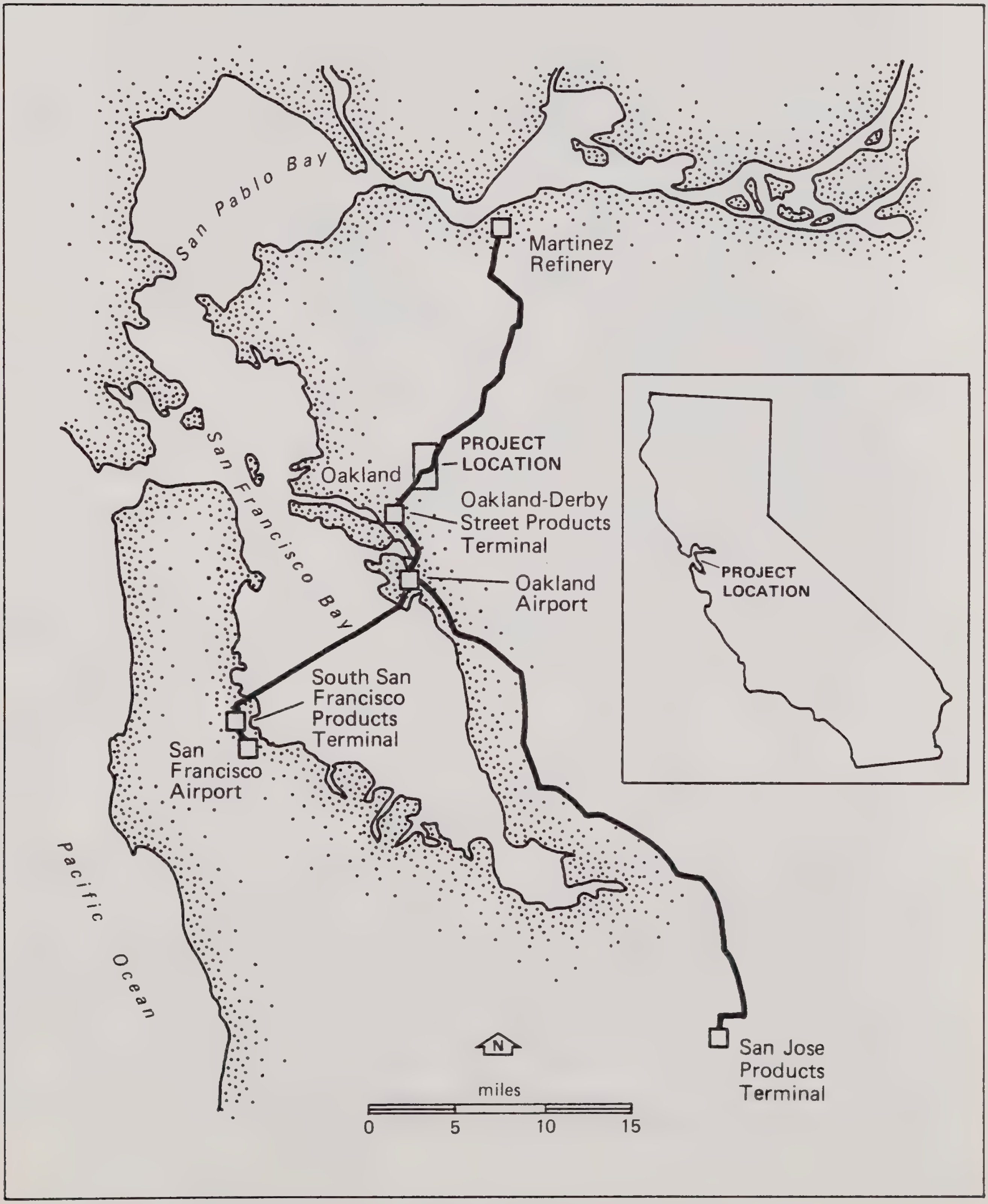


Figure 1. SHELL OIL COMPANY BAY AREA PRODUCTS PIPELINE

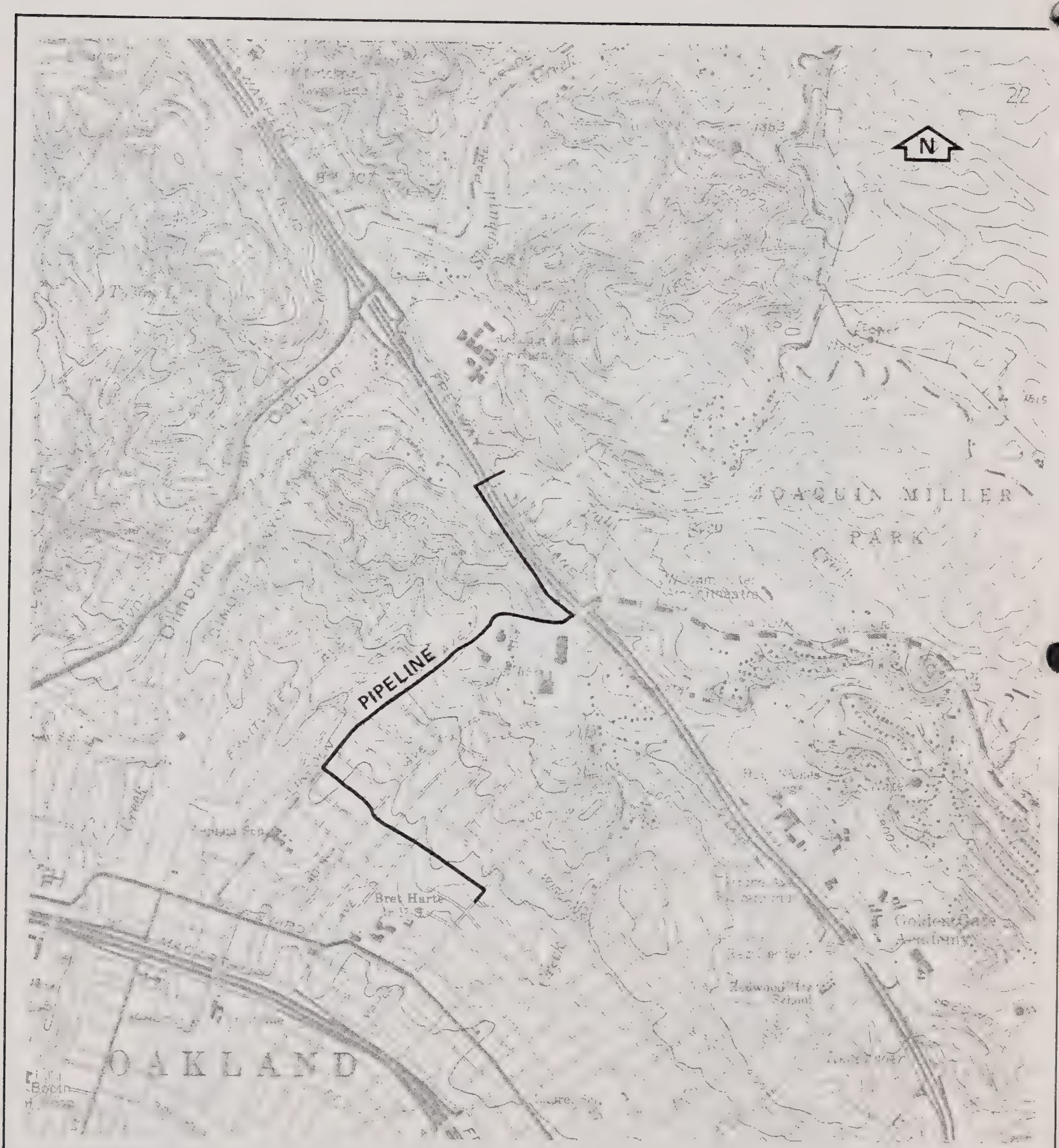


Figure 2. PROJECT LOCATION IN THE CITY OF OAKLAND

period of several years, and now a proposed route and pipeline design have been selected. The proposed project consists of approximately 9600 ft of new pipeline which would replace the damaged pipeline and would take an alternative route several hundred feet (approximately one-third mile at the nearest point) away from the London Road slide area (see Figure 3). The reviewer is referred to Ordinance No. 8649 which defines the legal relationship (in the form of a franchise) between the City of Oakland and Shell Oil Company (dated September 7, 1972).

This report is an Environmental Impact Report as required by City of Oakland policy and by the California Environmental Quality Act of 1970 (Amended). It was prepared for the City of Oakland by Woodward-Clyde Consultants of San Francisco, California. It describes the proposed project, the existing environmental setting, the predicted impacts, mitigating measures, and alternatives. The scope of this report covers the approximately 9600 ft of proposed new pipeline and the areas surrounding the new pipeline which may be affected during the construction and/or operating phases. It does not encompass the areas through which the existing pipeline passes. Note that the overall existing pipeline system is approximately 75 miles in all, about 12 miles of which are within Oakland.

This report concludes that, if the project is built and functions as planned, there will be no significant impact on the environment. However, the fact that the pipeline would transport flammable products through an area of residences, schools, and other institutions, makes it imperative to consider the consequences, should the system fail or an accident occur. This subject is discussed in Part B of this document.

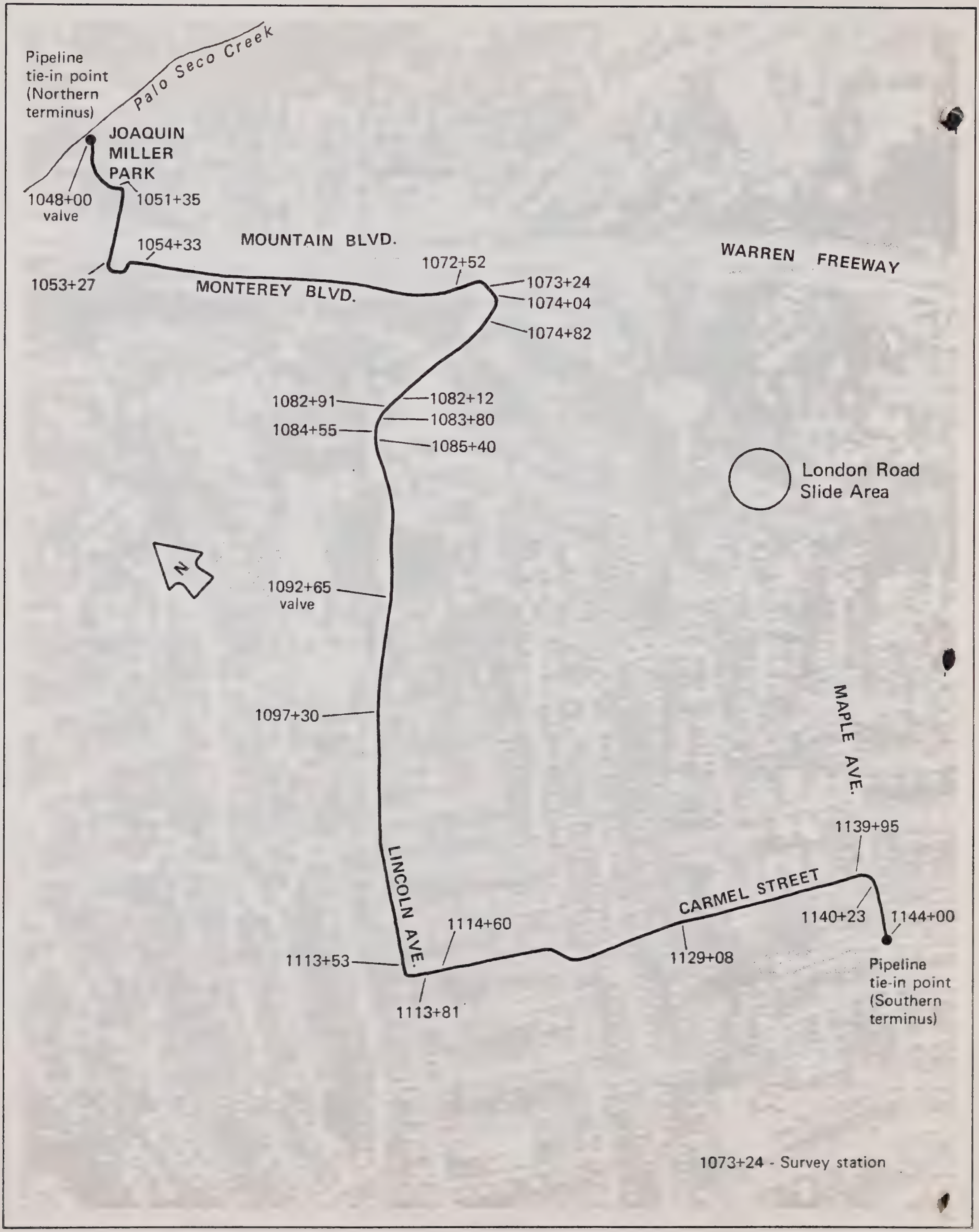


Figure 3. PIPELINE ALIGNMENT WITH SURVEY STATION

Section II

PROJECT DESCRIPTION

The proposed project consists of relocating a section of Shell Oil Company's Bay Area Products Pipeline through the Lincoln Heights neighborhood of Oakland. The existing 10.75-in. outside diameter (OD) pipeline to be relocated is a portion of a regional distribution system that transports turbine fuel, gasoline, and diesel fuel from the Shell refinery at Martinez, California, to five terminals located in the San Francisco Bay Area:

- Oakland - Derby Street Products Terminal*
- Oakland International Airport
- South San Francisco Products Terminal
- San Francisco International Airport
- San Jose Products Terminal

This regional distribution system and the location of the proposed pipeline relocation is shown in Figure 1.

SHELL'S RATIONALE FOR DEVELOPMENT

Shell Oil Company's Bay Area Products Pipeline has been out of service since January 1970. Shell states that completion of this project would restore the full use of its refined products distribution

*Located between the Park Street and Fruitvale Avenue bridges on the Oakland Inner Harbor Channel (the "Estuary").

system. When operating, the system would transport approximately 35,450 barrels per day of petroleum products (whose average mix tends to be approximately 61% gasoline, 37% turbine fuel, and 2% diesel fuel). The pipeline would be in service about 4.5 days per week, with maximum flow rates approaching 3,200 barrels per hour.

At the present time Shell transports its products to five distribution terminals in the Bay Area by an alternative route that includes the Southern Pacific Transportation Company's common-carrier pipeline. These interim arrangements are less desirable to Shell than operating their own integrated system.

The primary reason for Shell's decision to relocate the pipeline is related to the efficiency of operating their own pipeline distribution systems. Pipeline transportation systems tend to be safer and more economical than alternative systems. The chief economic advantages of pipeline transportation derive from the comparatively low operating and maintenance costs. The initial capital investment for construction of a pipeline is considerable, but these high fixed costs can normally be amortized over the long economic life of the system. The subject pipeline system has operated only about 5 years, has been out of service the last seven years, and will not be cost effective if it cannot be restored to operation.

The primary external benefit which would result from reopening the Shell pipeline would be the increased reliability of fuel deliveries (e.g., to the Derby Street Terminal, Oakland International Airport). With the shutdown of the Bay Area Products Pipeline in 1970, only one pipeline (Southern Pacific) was available to service the Oakland Airport. This was a source of concern to the Airport Commissioners who, in September of 1971, passed a resolution that stated in part:

> Any difficulty with the only available pipeline will result in serious impairment of the operating capacity of the airport, which, in turn, would have a damaging economic impact on Oakland and the East Bay community.

For much the same reason, World Airways said in a letter to the Port Board on August 30, 1971, that the reestablishment of the pipeline was essential for improved reliability of service to the airport.

PROPOSED ROUTE

After examining several alternatives in considerable depth, Shell and its engineering and geotechnical consultants have selected a new route that would circumvent the slide area on London Road (see Figure 3). At the north end of the proposed route, new construction would tie into the existing pipeline near Palo Seco Creek in Joaquin Miller Park. South from Joaquin Miller Park, the pipeline would cross beneath Mountain Boulevard and the Warren Freeway to Monterey Boulevard, run southeasterly on Monterey Boulevard to Lincoln Avenue, continue southwesterly on Lincoln Avenue to Carmel Street, and then southeasterly on Carmel Street to Maple Avenue where it would tie into the existing 10.75-in. OD pipeline. The total length of new pipeline would be approximately 9600 ft.

The new pipeline route would cross the Hayward earthquake fault zone and an unnamed fault that diverges from the main Hayward fault. These fault zones are considered potentially active. Extensive analysis of the earthquake and fault displacement hazard has led to the adoption of a design concept that is intended to avoid damage to the pipeline in the event of fault activity. Earthquake-resistant designs would be employed in construction across both fault zones. The earthquake and fault displacement hazard is discussed in Section III. The design concepts proposed to minimize hazards are presented in the project description that follows.

DESIGN FEATURES

Design concepts for the proposed 10.75-in. OD pipeline were developed by Bechtel Incorporated (San Francisco). The design and its bases are described in a report (*Final Report - Shell Bay Area Products Line, 1973*) and a set of detailed design drawings and specifications (these are available for public review). A report by Offshore Development Engineering, Inc. (by Dr. W. S. Tseng) which provides an independent assessment of the Bechtel design is also available for public review as is Bechtel's return response (*Supplemental Report — Pipeline Relocation and Design through the Hayward Fault Zone, August 1977*).

The new pipeline design is intended to protect the pipe from shear stress and breakage during a maximum probable earthquake of Richter magnitude 6.5 along the Hayward fault (Woodward-Lundgren and Associates, July 2, 1973). Such an earthquake is expected to cause both horizontal and vertical accelerations and displacement.

To protect the pipeline and favor its continued integrity during earthquakes, the sections of pipeline that cross the Hayward fault and an unnamed splinter fault would be placed inside an oversized casing so that the pipeline itself would be protected from excessive shear due to ground movement. About 72% of the total rerouted length will be placed in such a casing. Conventional burial would be used in constructing the sections where no pronounced displacements are expected (about 2710 ft of the total 9600-ft project). The pipeline design features and type of construction are described below and are summarized in Table 1 and Figure 4.

Casing Design

Casing size is based upon the anticipated vertical and horizontal displacement associated with the maximum probable earthquake along the Hayward fault. Three different casing designs would be employed in the construction of the pipeline to provide a flexible support system.

Table 1. PIPELINE DESIGN BY SURVEY STATION

Locations	Type of Construction	Length (ft)	Survey Stations* (Station to Station)
Joaquin Miller Park	Box Casing	335	1048+00 - 1051+35
Warren Freeway	Cylindrical Casing	192	1051+35 - 1053+27
Monterey Boulevard	Box Casing	106	1053+27 - 1054+33
	Arch Casing	1819	1054+33 - 1072+52
Monterey Boulevard/ Lincoln Avenue Intersection	Box Casing	72	1072+52 - 1073+24
	Arch Casing	80	1073+24 - 1074+04
	Box Casing	78	1074+04 - 1074+82
Lincoln Avenue	Arch Casing	730	1074+82 - 1082+12
	Box Casing	79	1082+12 - 1082+91
	Arch Casing	89	1082+91 - 1083+80
	Box Casing	75	1083+80 - 1084+55
	Arch Casing	85	1084+55 - 1085+40
	Conventional Burial	1190	1085+40 - 1097+30
	Arch Casing	1623	1097+30 - 1113+53
Lincoln Avenue/ Carmel Street Intersection	Box Casing	28	1113+53 - 1113+81
Carmel Street	Arch Casing	79	1113+81 - 1114+60
	Conventional Burial	1520	1114+60 - 1129+80
	Arch Casing	1015	1129+80 - 1139+95
Carmel Street/Maple Avenue Intersection	Box Casing	28	1139+95 - 1140+23
Maple Avenue	Arch Casing	377	1140+23 - 1144+00

SUMMARY

Box Casing:	801 ft (total)
Cylindrical Casing:	192
Arch Casing:	5897
Conventional Burial:	2710
	9600 ft

*See Figure 3 for Survey Stations Related to Pipeline Sections.

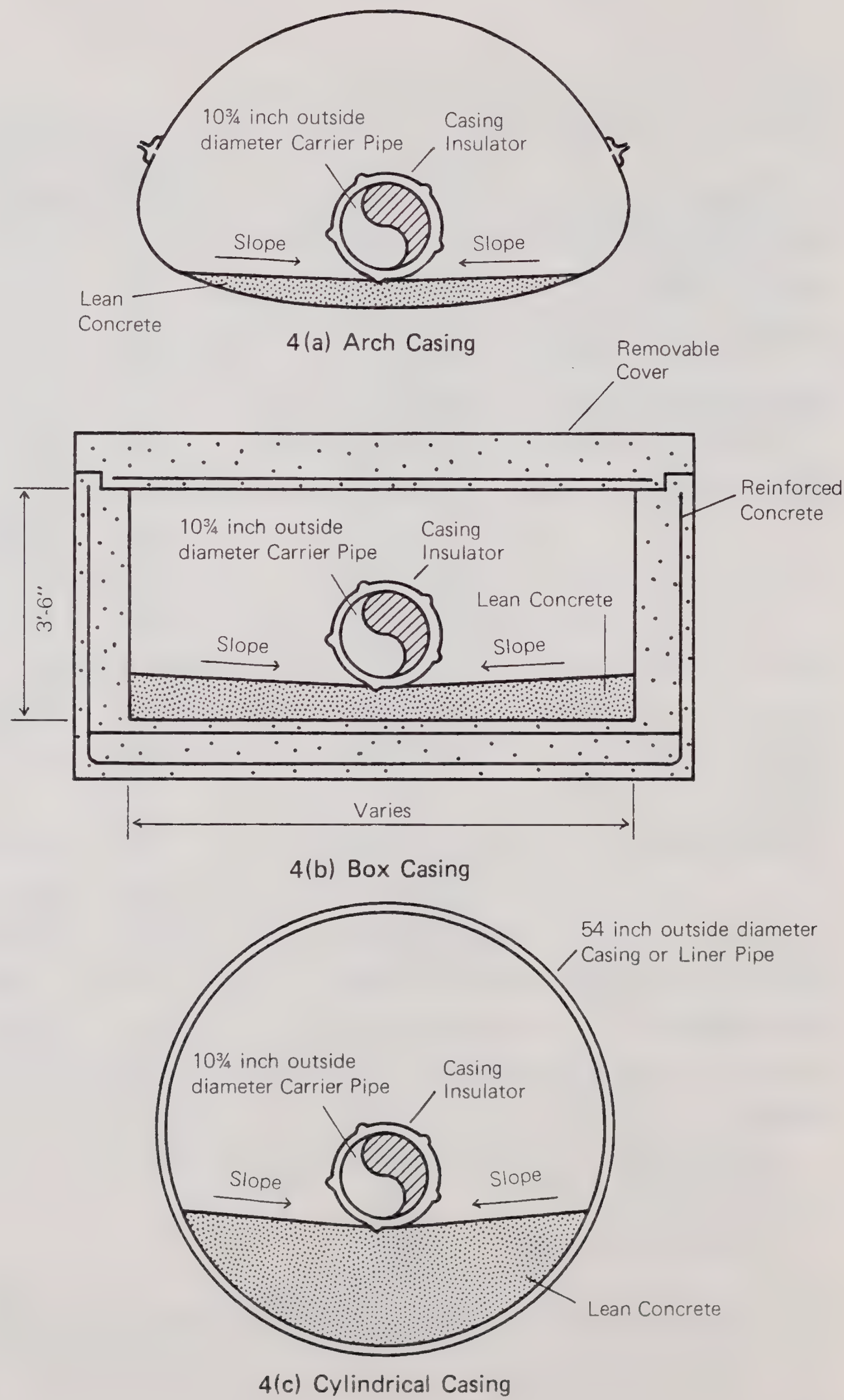


Figure 4. CROSS SECTIONAL VIEWS OF TYPICAL CASING DESIGNS AFTER INSTALLATION

A casing constructed with a corrugated metal pipe arch (5897 ft out of a total of 9600 ft) was selected for most of those portions of the pipeline subject to displacement. The lower half of the split pipe arch casing would be installed in the bottom of the ditch and then the top half would be bolted on. This top half could be removed in sections if access to the pipe were required. A cross section of a corrugated pipe arch casing is shown in Figure 4(a).

A limitation of the arch casing design is that it can only be used for relatively straight runs having horizontal and vertical bends greater than 250 ft radius. Where sharper bends occur along the route, a concrete box casing with a removable top would be used. The box casing would be either precast in sections or cast in place. Precast sections would be used where there is little interference from other utility lines buried in the street. Where precast sections cannot be used, the concrete casing would be cast in place. The concrete box casing construction is shown in Figure 4(b). A box casing would be used for 801 ft, total.

A cylindrical casing has been specified for the 192-ft pipeline section that would cross Mountain Boulevard and the Warren Freeway. See Figure 4(c). Unlike the remainder of the alignment, this section would be constructed by tunneling or by tunneling and jacking, rather than by digging a trench. Tunneling would avoid interference with traffic and eliminate damage to the road surface, two major problems in street surface construction. If the crossing were tunneled, the casing would be 54-in. OD Armco liner plate type construction. If the crossing were tunneled and jacked, the casing would be 54-in. OD steel pipe.

The pipeline would be supported by casing insulators, resting on a base of lean concrete inside the casing. This method was chosen over a series of structural steel supports for several reasons. The lean concrete would provide a continuous support of pipe, regardless of the

type of casing construction (thereby equalizing static stress and simplifying stress analyses by providing one friction factor to deal with).

For lateral support, the magnitude of friction factor required varies for the static and dynamic conditions. Low friction between pipe and support is desirable for static conditions, while higher friction (i.e., greater lateral restraint) is desirable for dynamic conditions. Due to the small order of magnitude of dynamic stresses, no lateral restraints have been specified. However, the lean concrete layer would have lateral slopes (up to 5 percent) towards the center of the casing. This would provide a centering mechanism for the pipe to slightly restrain it from expected creep due to temperature changes.

By locating the pipeline underground throughout its entire length, it is anticipated that it will be relatively immune to wanton or accidental acts of harm. It is conceivable that concerted, well-planned acts of vandalism could still damage the system and could result in a threat to public safety, but both the magnitude of the threat and its likelihood of occurrence would appear to be less than those associated with aboveground fuel handling facilities.

Positive steps have been taken to minimize the likelihood of accidentally damaging the proposed pipeline. Shell Oil Company has arranged with the City of Oakland to file detailed maps showing the precise installed location of the pipeline and appurtenant facilities. The Public Works Department will record the pertinent information on the detailed maps it uses to grant construction and excavation permits. This active program, plus the fact that the pipeline is buried 3 ft or more (cased in some places) under paved public streets, makes it unlikely that someone will inadvertently damage the pipeline while excavating for some other purpose.

Valves

A total of 13 valves (9 gate valves and 4 check valves) would be located between the Martinez Refinery and this project's southern terminous (i.e., survey station 1144+00 on Maple Avenue); see Figure 5. Two gate valves exist at present, the additional eleven are proposed to improve safety and operational control. Along the route of the proposed relocated pipeline, gate valves would be located in Joaquin Miller Park (at survey station 1048+00, approximately 300 ft north of the freeway) and on Lincoln Avenue (at survey station 1092+65, approximately 400 ft downhill from the Greek Orthodox Church parking lot); see Figure 3. The valves would be underground, vault-enclosed, automated, remote-control gate valves. They have been strategically located (along with the other gate and check valves in the total pipeline system) to reduce spillage in the event of a failure of the pipe. The design of the automated gate valve permits the automatic closure of the valve as a result of one or more of the following occurrences:

1. Loss of DC control voltage
2. Low valve actuator nitrogen gas pressure
3. Loss of telecommunications
4 Low line pressure
5. Excitation of accelerometer/earth movement instrumentation

The valve is so designed that occurrences (such as the first three indicated above), which would prevent the valve from closing as a result of a drop in line pressure or earth movement, will cause the valve to close thus reducing the probability of mechanical failure in the event of a major occurrence. The valves could also be opened or closed by command from the Martinez Control Center.

Once closed as a result of any of the first four conditions, the valves would be inspected and the controls reset at the valve site. A valve closed as a result of condition five could be reopened by the

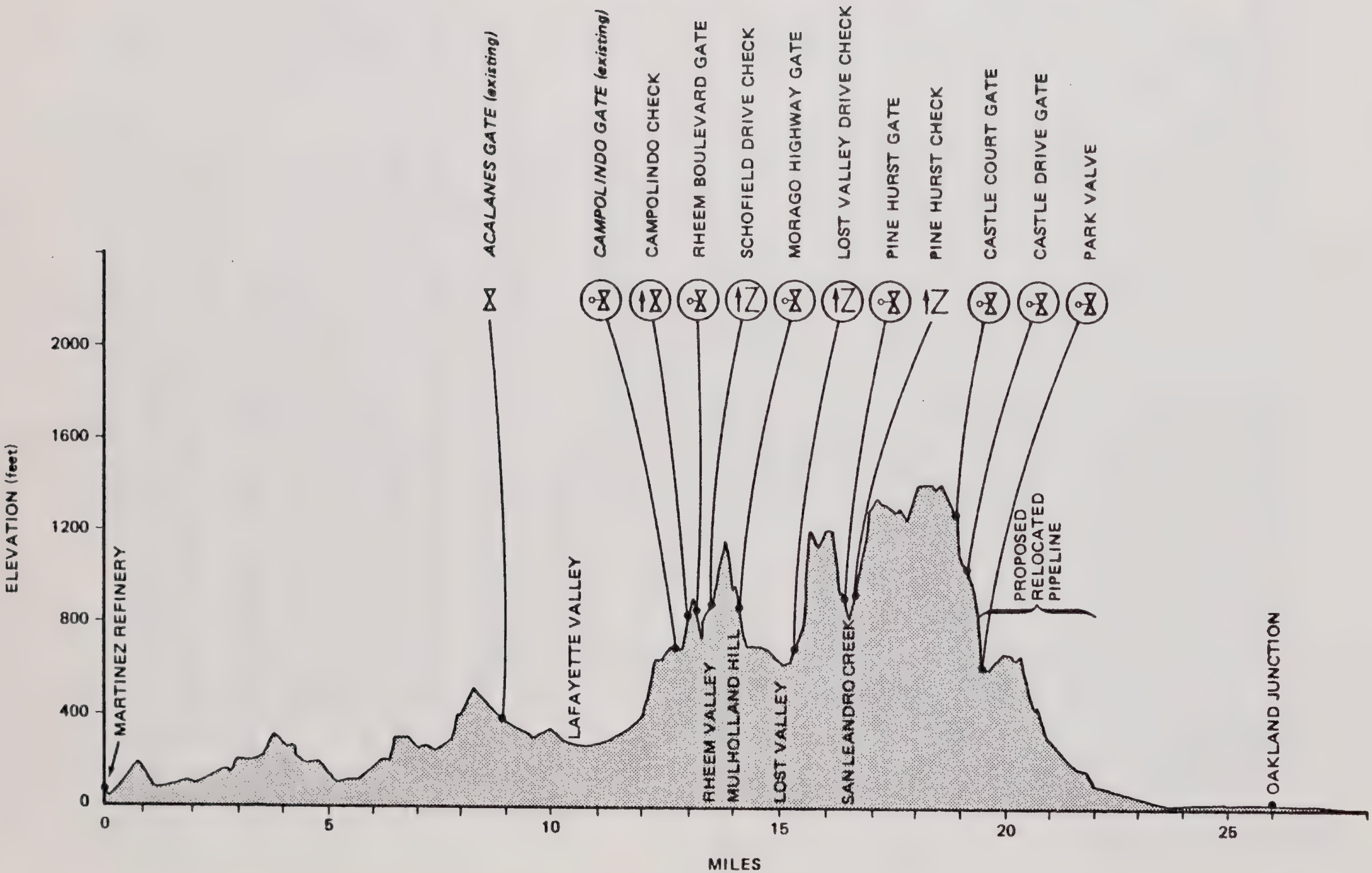


Figure 5. VALVE STATIONS BETWEEN MARTINEZ REFINERY AND SOUTHERN TERMINUS OF THE RELOCATED PIPELINE

Martinez Control Center if, upon restoration of communications, inspection shows that the original closing was not caused by any of the first four conditions. A valve could also be reopened by Martinez Control Center if closed by the fourth condition, if telemetered pressure and line integrity balance show that the pressure drop was caused by line operation and not by a leak. A valve closed by the Martinez Control Center could be reopened by remote control, if no abnormal conditions exist.

Casing Drainage and Vents

Subsurface hydrologic information obtained by Woodward-Lundgren and Associates indicates that groundwater will be generally lower than the top of the casing. However, surface water would tend to percolate through the soil and could enter the casing through the field joint seams. Therefore, the casing would have drains and/or pumpout facilities at the low points.

Drains and/or pumpouts would be installed with the valve in Joaquin Miller Park (survey station 1048), at the low point on Monterey Boulevard (survey station 1054), and at the low point on Lincoln Avenue (survey station 1113). Each drain would be a 4.5-in. OD pipe equipped with a valve discharging into natural or man-made waterways. The drain valve would be kept closed except as necessary for draining operations. If products enter the casing due to a leak or a spill, the drain valves could be connected to a tank truck to pump out the product.

Casing vents would be installed at the high points along the casing. These vents would be 2 in. pipes connected to the top of the casing, their purpose being to aerate the vapor space within the casing. Each vent outlet has been designed to prevent foreign objects from entering the casings.

Construction Techniques

The pipeline would be located beneath existing roadways and would be placed in a trench dug mechanically and by hand (with the exception of the 192 ft bored under the Warren Freeway and Mountain Boulevard). The trench would have to be deep enough to provide the required minimum cover of 3 ft over the casing and 4 ft over the pipeline (where it is buried directly). Where the route crosses existing underground utilities (e.g., drain pipes, other pipelines, cables), the casing would cross under the utility lines unless there is depth enough to permit it to cross over, maintaining the minimum 3-ft depth of cover. Wherever the pipeline crosses under existing utility lines, it would pass under with a minimum clearance of 12 in. (see Figure 6). Since arch casing cannot accommodate sharp vertical bends, gradual bends would be made where the casing would cross utility lines. Once in place and covered, the pipeline would be completely out of view and would not interfere with pedestrian or vehicular circulation.

Several types of equipment would be utilized during construction. Backhoes would be used to excavate the trench; loaders would move and transport spoil; dump trucks would deliver backfill material; cranes and large trucks would transport and unload material. Small trucks and hand-tools would also be used.

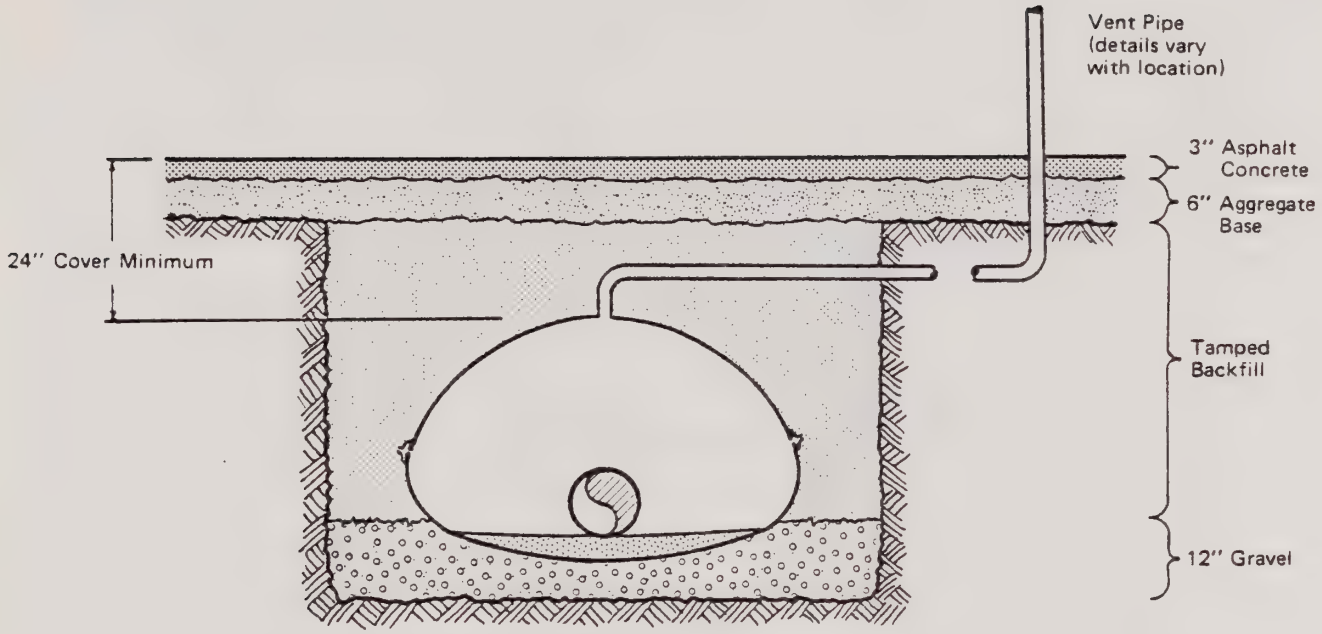


Figure 6(a). TYPICAL INSTALLATION BENEATH ROADWAY (CYLINDRICAL AND BOX SECTION CASINGS ARE SIMILAR)

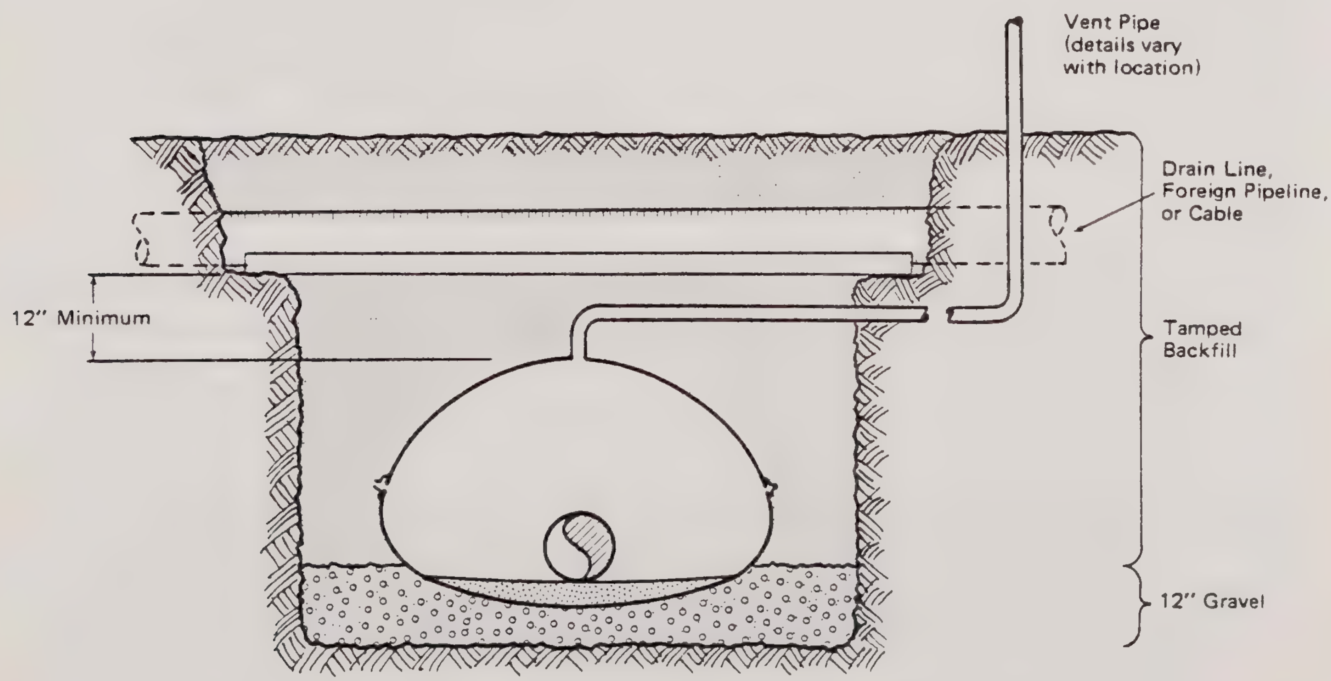


Figure 6(b). TYPICAL CROSSING OF EXISTING PIPES AND CABLES (CYLINDRICAL AND BOX SECTION CASINGS ARE SIMILAR)

Section III

ENVIRONMENTAL SETTING

The setting for the proposed development is described in the following subsections. Principal features and existing conditions are described in terms of the following subject areas:

- Land use
- Topography
- Geotechnical considerations
- Meteorology/air quality
- Noise
- Hydrology/water quality
- Biology/ecology
- Socioeconomic considerations
- Transportation
- Historical/archaeological resources

The discussion concerns present conditions. The impacts associated with the proposed project are described in Section IV.

LAND USE

In order to describe the site environment and discuss the impacts of this project, the proposed pipeline route has been divided into several sections based upon land use and vehicular traffic (see Figure 7).

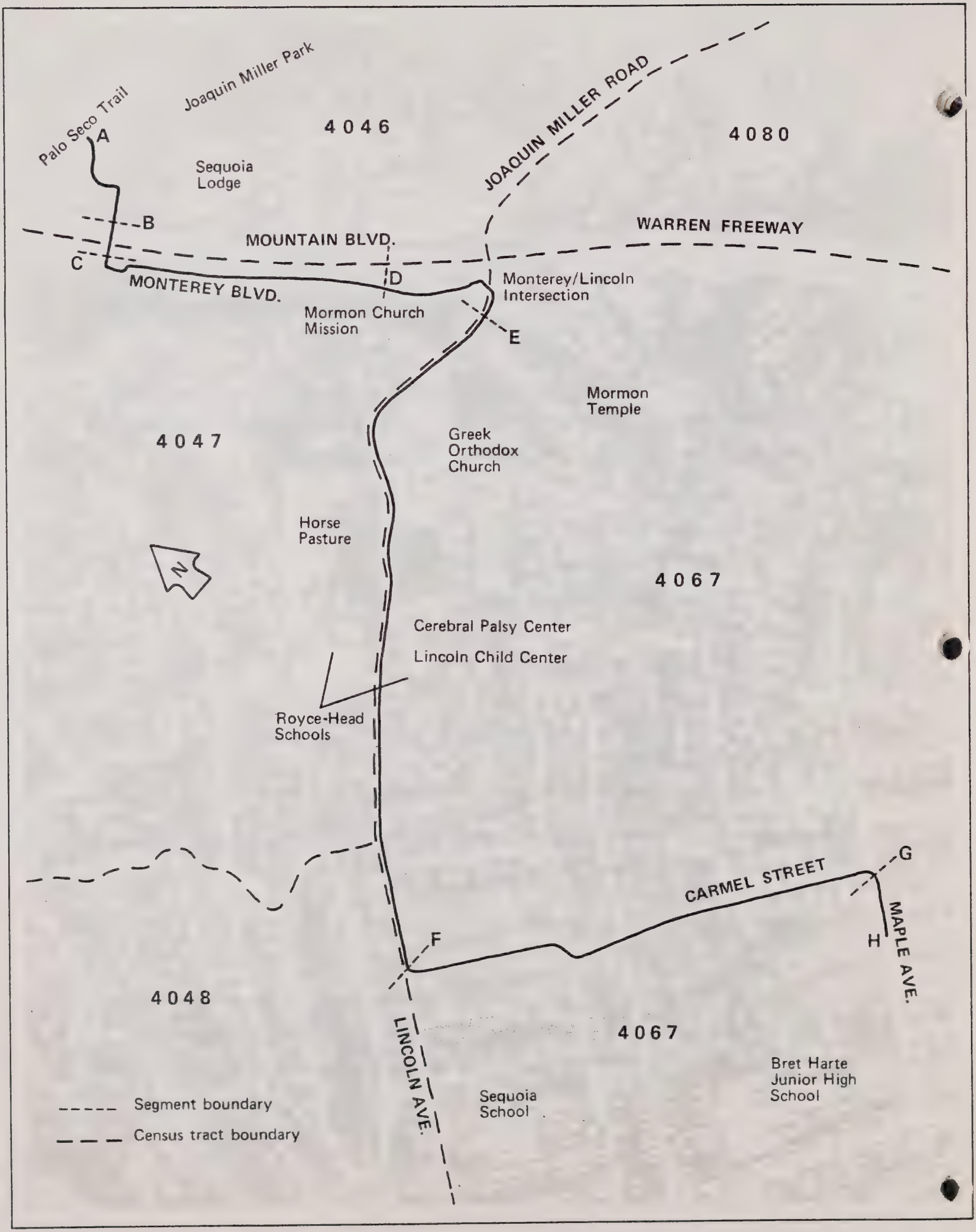


Figure 7. LOCATION OF PIPELINE SEGMENTS INCLUDING INSTITUTIONAL FACILITIES AND CENSUS TRACTS

The street and highway network consumes a high percentage of the surrounding land area. The proposed pipeline route is located along functional roadways for its entire length. The 335-ft section within Joaquin Miller Park is located in an abandoned roadway. The remainder of the adjacent land is devoted primarily to residential and institutional uses.

Joaquin Miller Park

Near Sequoia Lodge the proposed pipeline would travel through the only relatively undisturbed area along the proposed route. The pipeline would be placed in a 30-ft-wide abandoned roadway that serves as a pedestrian access to Palo Seco Trail. This section of cased pipeline would replace the existing direct burial line.

The area between the northern terminus of new construction and Mountain Boulevard is a steep-walled glen cut by Palo Seco Creek. The dense vegetation cover in this section is mostly natural. The only visible signs of man are two crumbling stone weirs along Palo Seco Creek and the abandoned roadway.

The entrance to Sequoia Lodge is immediately adjacent to the proposed route before it crosses underneath Mountain Boulevard and the Warren Freeway. The lodge and its facilities are within Joaquin Miller Park and are operated by the City of Oakland Department of Parks and Recreation. The area immediately adjacent to the Sequoia Lodge entrance is heavily vegetated and similar in appearance to the remainder of Joaquin Miller Park.

Warren Freeway

This section includes the Warren Freeway (135 ft wide), and Mountain Boulevard (30 ft wide). The Warren Freeway is a four-lane limited-access freeway. Mountain Boulevard is a two-lane frontage road

which parallels and serves the Warren Freeway. Near the proposed route, neither of these thoroughfares have sidewalks. The natural environment in this section has been replaced for the most part by highways, auxiliary structures, and landscaping.

Monterey Boulevard

After passing southwest beneath the Warren Freeway, the route turns southeast and parallels the freeway along Monterey Boulevard (30 to 35 ft wide) until it intersects with Lincoln Avenue. Adjacent to the proposed route on the southwest side of Monterey Boulevard there are several homes, the Mormon Church Mission, and a parking lot. The Lincoln Avenue exit from the Warren Freeway lies about 200 ft northwest of Lincoln Avenue on the northeast side of Monterey Boulevard. Monterey Boulevard is separated from the Warren Freeway by a narrow 6-ft-wide strip landscaped with introduced shrubs and a 6-ft chain-link fence.

Monterey/Lincoln Intersection

This intersection serves as an interchange with the Warren Freeway. Vehicular access is provided to both sides of the freeway. The next freeway interchanges are Park Boulevard (0.75 miles to the north) and 35th Avenue/Redwood Road (about .8 miles to the south).

Lincoln Avenue

Lincoln Avenue is a primary thoroughfare (35-40 ft wide) that connects the Warren and MacArthur freeways (refer to Figure 2). There is a dedicated sidewalk along both sides of Lincoln, although it is not continuously surfaced on the northwest side. Along both sides of the street, the AC Transit Company has designated bus stops.

There are several institutional facilities located on either side of Lincoln Avenue, adjacent to the proposed route:

- The Mormon Temple and associated facilities
- The Greek Orthodox Church
- The Cerebral Palsy Center for the Bay Area
- The Lincoln Child Center
- The Head-Royce Schools

Their locations are shown in Figure 7.

On the northwest side of Lincoln Avenue, across from the Greek Orthodox Church, a horse pasture is located along the Whittle Street Branch of Sausal Creek. It is the only rural feature along Lincoln Avenue. The rest of the land adjacent to the proposed pipeline route in this section contains residential structures.

Carmel Street

Carmel Street is a narrow residential street with 30 ft of road surface. It is important locally, in that it connects Lincoln and Maple avenues and provides north-south travel at the foot of the Berkeley Hills. Single-family dwellings face Carmel Street from Lincoln Avenue to Coolidge Avenue. Fifteen or more apartment houses are located on Carmel Street between Coolidge and Maple avenues.

Maple Avenue

Maple Avenue is a residential street with sidewalks on both sides. There is a small market on Maple Avenue just west of Carmel Street which is the only commercial establishment along the proposed route.

In summary, the areas adjacent to the proposed route display little evidence of the original natural environment, except for the section within Joaquin Miller Park. The overall slope configurations are similar to those that existed before urban development. Drainage courses tend to follow their original paths, although in most places

the flow has been channelized to pass through man-made drainage systems. Residential and institutional structures in association with streets and highways are the primary land uses along the proposed route.

TOPOGRAPHY

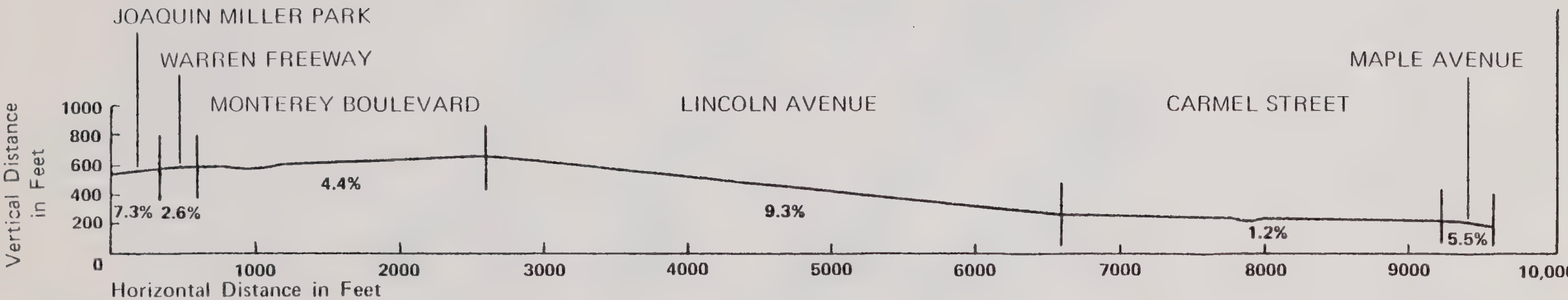
Topographically, the area adjacent to the proposed pipeline route consists of sloping terrain with a southwestern orientation drained by four small creeks: Shepard Creek, Palo Seco Creek, the Whittle Street Branch of Sausal Creek, and Peralta Creek. Although natural drainage has been altered and channeled as a result of development, it continues to flow generally from northeast to southwest.

The proposed route also slopes from northeast to southwest. The straight-line distance from the origin of new construction to the terminus is approximately 5500 ft. The change in elevation is 282 ft, and the overall average grade is approximately 5.2 percent. A topographic profile is shown in Figure 8. Following the proposed route (approximately 9600 ft long), the overall average grade is 3.1 percent. The highest point is 665 ft above MSL (located at the intersection of Monterey Boulevard and Lincoln Avenue). The lowest point is 264 ft above MSL (located near the intersection of Maple Avenue and Carmel Street).

GEOTECHNICAL CONSIDERATIONS

The geology in the vicinity of the proposed pipeline realignment is shown in Figure 9, which uses a base map prepared by the U.S. Geological Survey (Radbruch, 1969).

The oldest rocks in the vicinity of the site are shales, sandstones, cherts, and some conglomerates of the Upper Jurassic Knoxville Formation



Percents are the grade that exists between the named points

Figure 8. GENERAL TOPOGRAPHIC PROFILE OF THE PROPOSED PIPELINE ROUTE

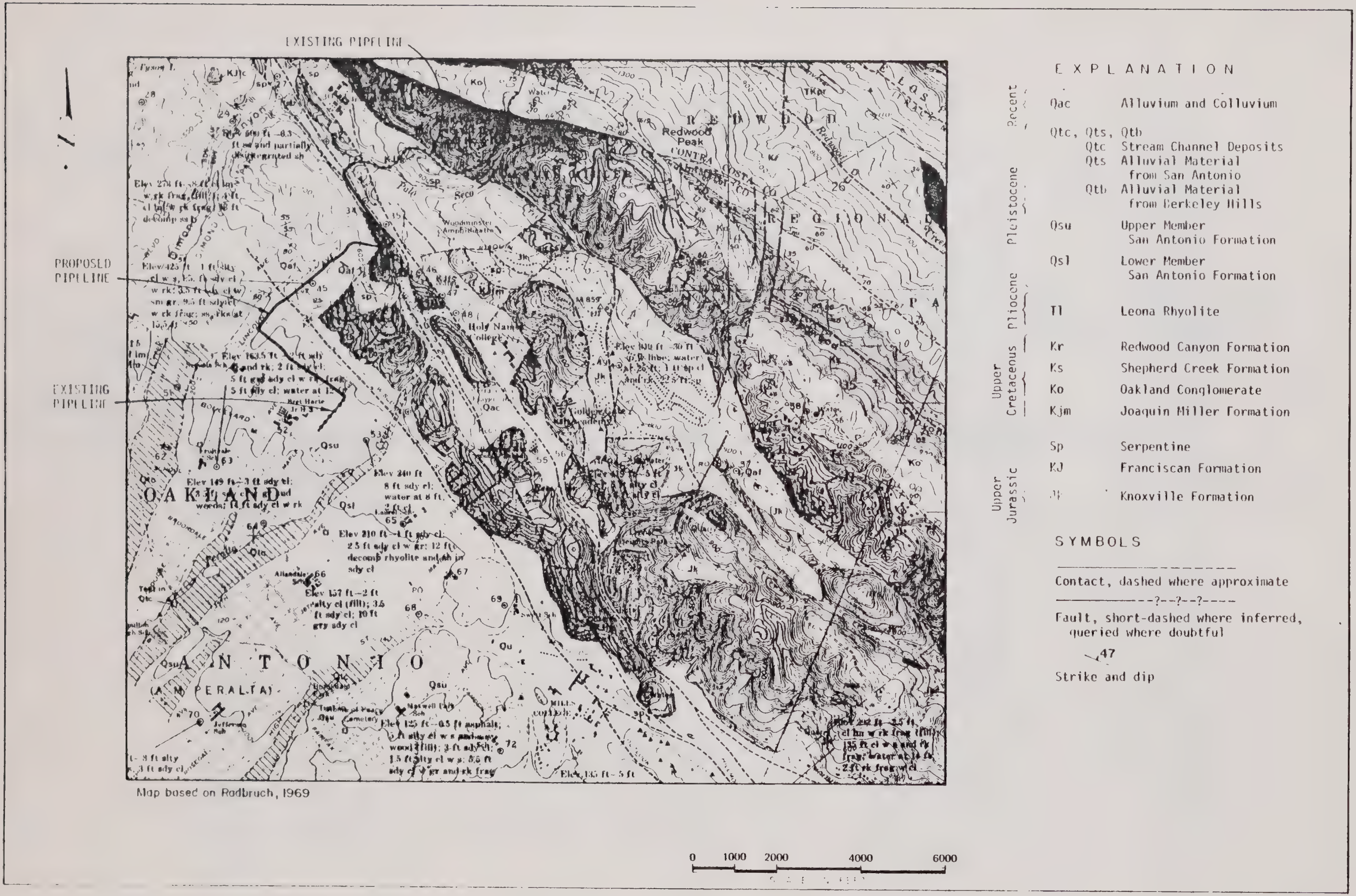


Figure 9. LOCAL GEOLOGY—BAY AREA PRODUCTS PIPELINE—LINCOLN AVENUE ALIGNMENT

and the Jurassic and Cretaceous Franciscan Formation. Serpentine is associated with these formations and may be of similar age. For the most part, the Knoxville and Franciscan rocks with serpentine and the Pliocene-aged Leona Rhyolite are located in a wedge about one mile wide, between the Chabot fault on the east and the Hayward fault zone on the west, as shown in Figure 9. Rocks east of the Chabot fault consist of shale, sandstone, and conglomerate of the Upper Cretaceous-aged Joaquin Miller Formation, Oakland Conglomerate, and the Shepard Creek Formation.

West of the Hayward fault zone, Quaternary sediments overlie the older rocks. These sediments include the Pleistocene-aged San Antonio Formation with a lower member of mainly gravel and an upper member of clay silt and sand. These sediments were primarily derived from older rocks in the upland areas and deposited during the Pleistocene Epoch. Younger Pleistocene sediments of the Temescal Formation, consisting of stream channel deposits derived from the San Antonio and older formations, are found along Peralta Creek, Dimond Canyon, and High Street. Quaternary deposits cover the broad alluvial plain to the west. Temescal and San Antonio sediments have been encountered beneath the alluvial sediments and are believed to extend westward beneath San Francisco Bay.

Structurally, the Hayward fault zone is the dominant geologic feature in the local area. The fault zone is typically identified by physiographic features such as elongated depressions, offset streams and ridges and similar features typical of active fault zones. A queried fault trace extends across the Lincoln Avenue realignment site (USGS, Radbruch, 1969). The trace joins the Hayward fault zone about three miles south of the project site. The Chabot fault joins the Hayward fault zone about 1.5 miles north of the project site. Northwest trending faults offset the Chabot fault at several locations.

The proposed pipeline route begins in Joaquin Miller Park where the existing pipe in underlain by shale, sandstone, and some conglomerate

of the Joaquin Miller Formation. The pipeline would cross the Chabot fault east of Palo Seco Creek, as shown in Figure 9. Survey data from a Woodward-Clyde & Associates (WC&A) report dated August 5, 1970, suggests that creep may be occurring further south along the Chabot fault; however, this has not been confirmed by field evidence. The Chabot fault is considered potentially active in that report, based on its relationship to the Hayward fault.

The pipeline route continues westward in rocks of the Franciscan Formation and into the active Hayward fault zone in the vicinity of the Warren Freeway. Several individual fault traces have been located by means of aerial photographs and published data. These traces are shown on Figure 10. The two westernmost traces appear to be undergoing active creep, based on data contained in the WC&A report referred to above. The pipeline route continues in the fault zone beneath the Warren Freeway to Monterey Boulevard. It then continues south along Monterey Boulevard to Lincoln Avenue where it turns westward and leaves the Hayward fault zone. Test boring data contained in the WC&A report dated June 5, 1970, indicates that the pipeline route is underlain by the gravels of the lower member of the San Antonio Formation. It continues with this underlying formation along Carmel Street to Maple Avenue, where the new pipeline route would intersect the existing pipeline route.

The proposed pipeline route crosses the queried fault trace, reported by the U.S. Geological Survey (Radbruch, 1969). This fault trace is considered potentially active by the State of California Division of Mines and Geology and is placed within the Special Studies Zones established by the State Legislature (AB-520). These zones are discussed below.

Under the Alquist-Priolo *Geologic Hazard Zones Act* (AB-520), the California State Legislature has directed the State Geologist to delineate special studies zones along all "potentially active" and "active"

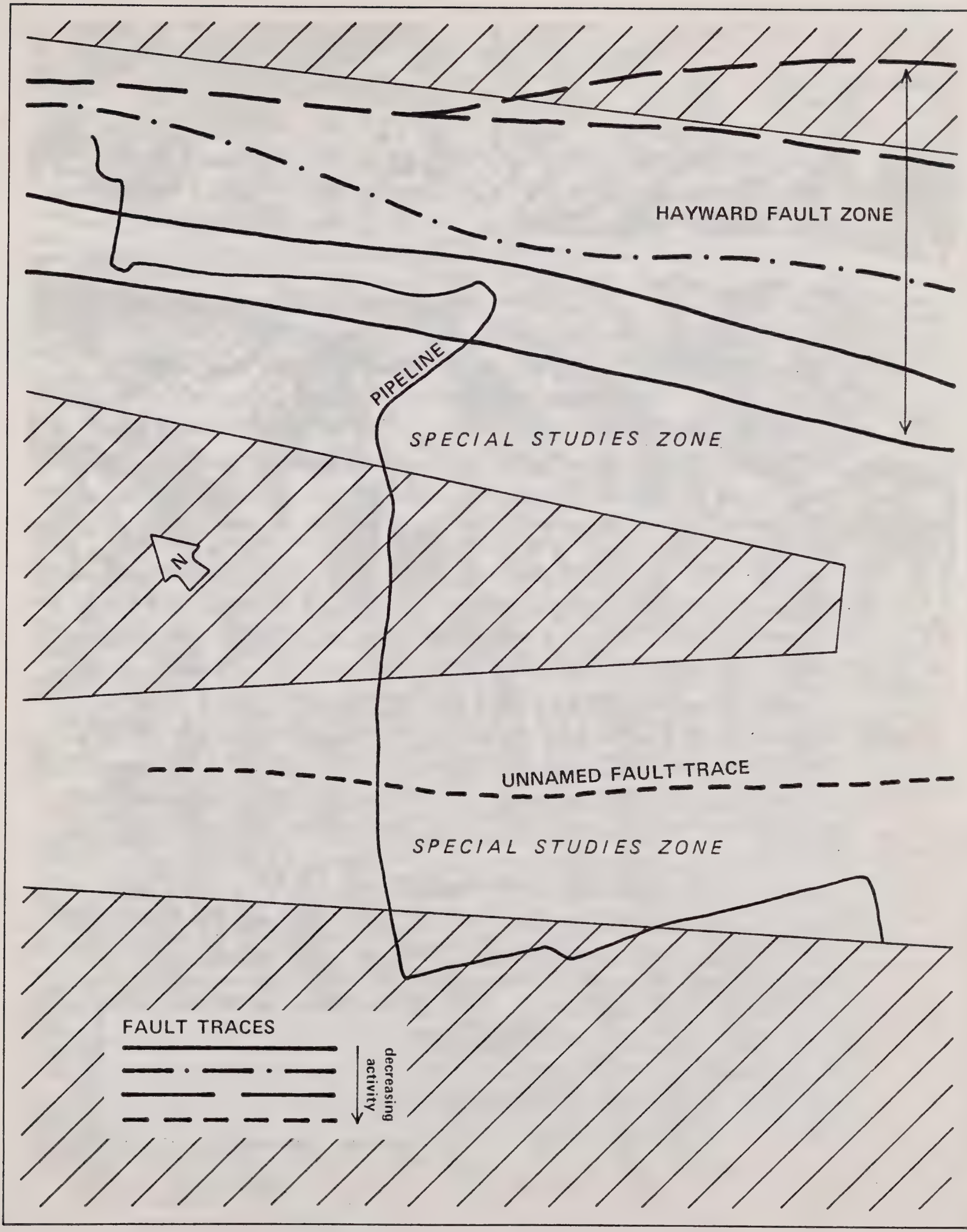


Figure 10. FAULT TRACES AND SPECIAL STUDIES ZONES

faults. An "active" fault is defined by the State Mining and Geology Board as any fault which has had surface displacement within Holocene time (about the last 11,000 years). They define a "potentially active" fault as any fault having surface displacement during Quaternary time (the last 3,000,000 years).

According to the act, "...the site of every proposed new real estate development or structure for human occupancy shall be approved by the city or county having jurisdiction over such land...." Also, "cities and counties shall not approve the location of such a development or structure within a delineated special studies zone if an undue hazard would be created, and approval may be withheld pending geologic and engineering studies to more adequately define the zone of hazard."

Based on the criteria developed by the State Mining and Geology Board, the Chabot fault has not been identified as potentially active and is not included within a special studies zone. Since northwest-trending faults offset the Chabot fault, they must have had more recent movement. The northwest-trending faults are, in turn, offset by the Hayward fault, making it the most recently active. Neither the Chabot nor the northwest-trending faults are included within a special studies zone. Based on historic activity, the Hayward fault zone has been included in a special studies zone (Special Studies Zones, 1974). The Pleistocene-age San Antonio Formation is shown to be displaced by a queried fault trace west of the primary Hayward fault zone (Radbruch, 1969). Based on State criteria, this trace is included in a special studies zone by the California Division of Mines and Geology.

The Hayward fault zone has experienced surface rupture twice within the last 141 years. In 1836, the fault ruptured from Warm Springs to San Pablo, a distance of approximately 44 miles. In 1868, the fault zone experienced surface faulting from Warm Springs to Mills College, a distance of 26 miles (Tocher, 1959).

At the present time, slow fault creep is occurring along portions of the fault from Fremont to Richmond. The fault is reportedly creeping at the rate of approximately 7 millimeters per year; however, this varies from place to place and time to time.

The location of probable active fault traces are shown in Figure 10. The locations are based on previous geologic mapping, examination of geologic contacts, field observation, available geological information, and a detailed study of aerial photographs. Based on available information, these figures represent the most exact location of active fault traces that are possible from surficial observations. However, some movement may occur along other fault traces within the fault zone.

The fault zone traces shown in Figure 10 are those most likely to experience movement during the next major earthquake along the Hayward fault. Most of this movement will occur along one or more of the fault traces within the broad fault zone. Movement along individual traces can be expected to disturb a band of earth 4 to 6 ft wide within the fault zone. Fault creep is occurring now and will continue to occur along one or more of the fault traces within this zone. Fault creep can be expected to move the western side of the fault northerly in relation to the eastern side at a rate ranging from 3.5 to 7 millimeters per year. (Woodward-Lundgren & Associates, July 2, 1973).

A stability analysis was performed for the steepest slopes along the Lincoln Avenue alignment. The results are reported in the WC&A report dated June 5, 1970. The field investigation included 14 test borings, several refraction seismic traverses, and detailed geologic mapping along the proposed pipeline route. Samples were selected for such laboratory tests as moisture content, dry density, and unconfined and triaxial compression tests. The strength parameters used for calculations of slope stability included cohesion, angle of internal friction, and density of the earth materials.

The analyses were based on the following assumptions concerning the physical conditions at the site:

- The stability of the slope will be controlled by resistance to sliding along an established plane of weakness. As far as is known, there are no adverse planes of weakness in the slope.
- Present stability of the hillside is due to cohesion and friction and other strength parameters inherent in the material.

In order to evaluate the stability of a given slope, the driving force in favor of sliding is compared to the resistance due to frictional forces along the plane of weakness. If the resisting forces are divided by the driving forces, a safety factor can then be obtained for sliding. If the safety factor is less than unity, there is a greater potential for sliding.

Using this method, the stability of the existing slide at London Road was compared to that along Lincoln Avenue. The maximum factor of safety obtained at the London Road slide equals unity, while the maximum factor of safety at Lincoln Avenue is almost four and always exceeds unity. This analysis was conducted for the outside edge of the slope; therefore, the factor of safety becomes greater for the inside edge of Lincoln Avenue, where the proposed pipeline would be located (WC&A, June 5, 1970). This analysis indicates that the inside edge of Lincoln Avenue has a high safety factor and a low potential for sliding.

METEOROLOGY/AIR QUALITY

The general climate of the San Francisco Bay Area is of the coastal Mediterranean type. Climatic extremes are mild, with summer highs rarely exceeding 100^{o}F and winter lows usually averaging above freezing. Cooling fog during the summer months usually limits extreme summer highs.

The rainfall varies between 12 and 20 in. with isolated areas in the surrounding hills having much greater rainfall. The prevailing winds are influenced by oceanic weather conditions and rarely exceed 40 mph in low-lying areas. Normal winds are less than 10 mph and come from the west slightly more often than from other directions. The atmosphere during July and August is the most stable, resulting in higher air pollution levels.

It can be assumed that the general climatic factors do not change appreciably along the route. The closest weather station is at the Oakland Airport. The airport is close to sea level and about 5 miles southwest of the proposed route. Most of the weather data available for the Oakland Airport is generally representative of project site conditions. An exception is the wind conditions. The airport winds are generally somewhat stronger than site winds. Figure 11(a) is an annual wind rose developed from eight years of data at the Oakland Airport. It indicates that the greatest wind speeds are associated with the prevailing west direction. Winds blow directly from the west about 16 percent of the time with speeds averaging 10 mph. This would result in winds blowing towards the site from downtown Oakland. Winds blowing from the surrounding hills towards the site (ENE, NE, and NNE) occur about 10 percent of the time at about 5 mph. Figure 11(b) is a frequency-occurrence diagram showing the distribution of annual wind speeds. The average wind speed at the airport is about 6 mph. The average speed at the project is expected to be less, due to its more protected location.

Figure 12 shows the average monthly temperature and precipitation recorded at the airport. Expected conditions in the project area will be similar. The months of December through March account for about 75 percent of the annual rainfall, while little rain occurs during the summer. January, with almost 4 in. of rain, is the wettest month. The

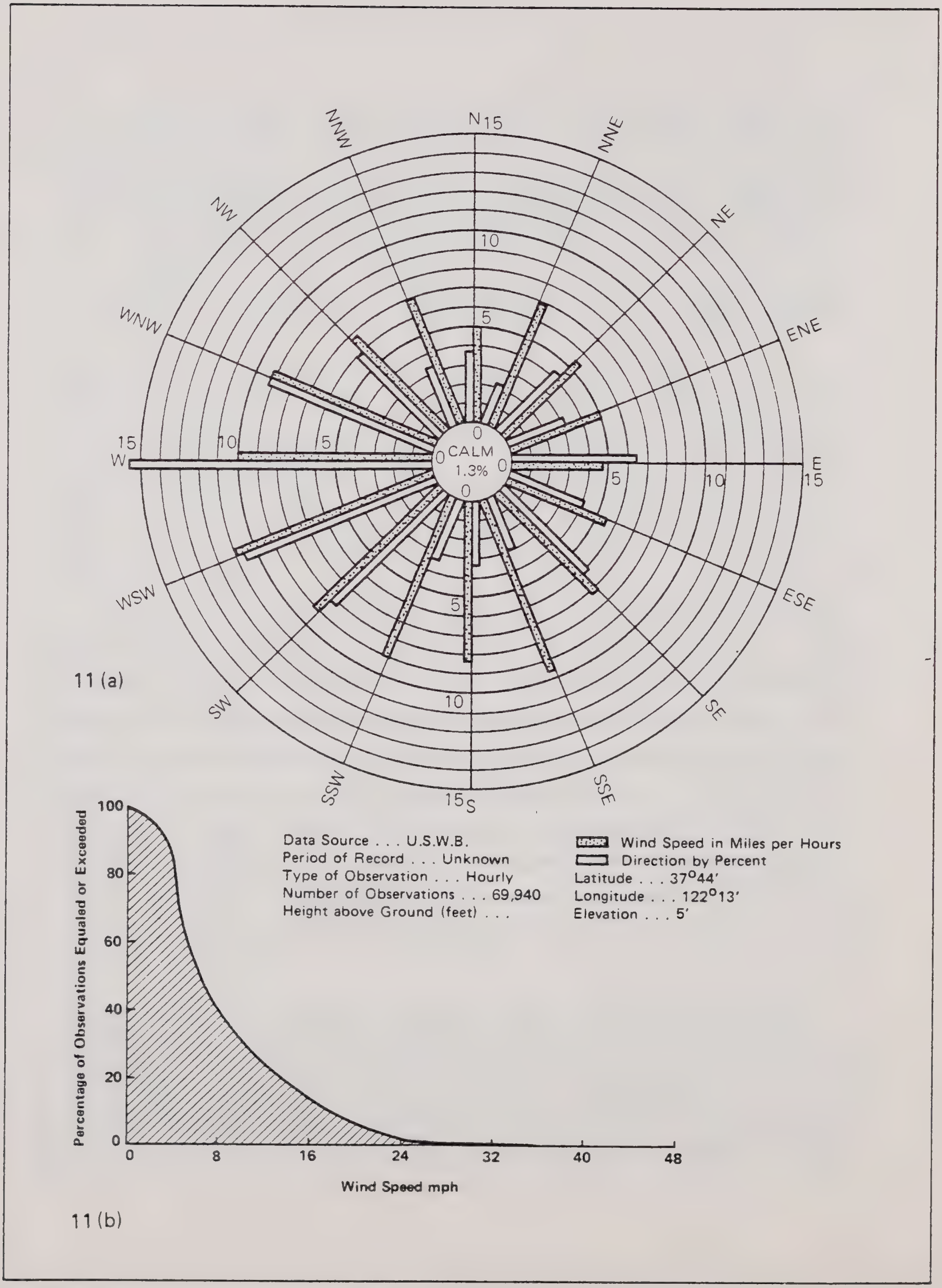
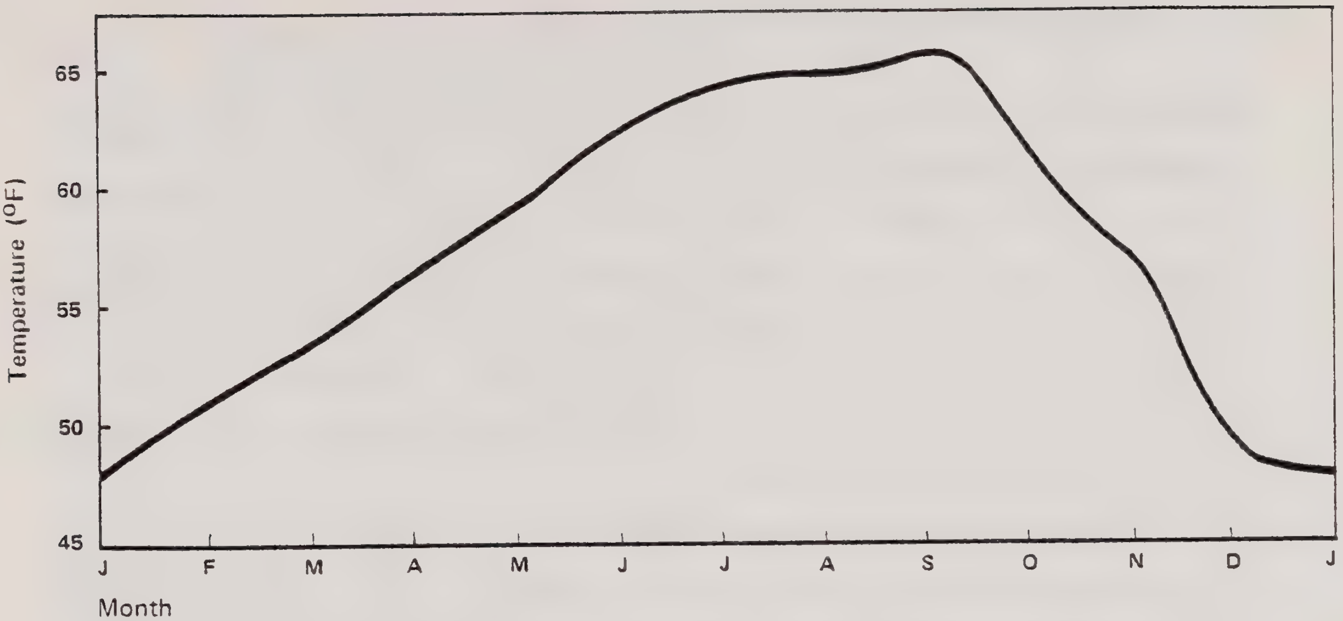


Figure 11. ANNUAL WIND ROSE AND DISTRIBUTION OF WIND SPEED, OAKLAND AIRPORT



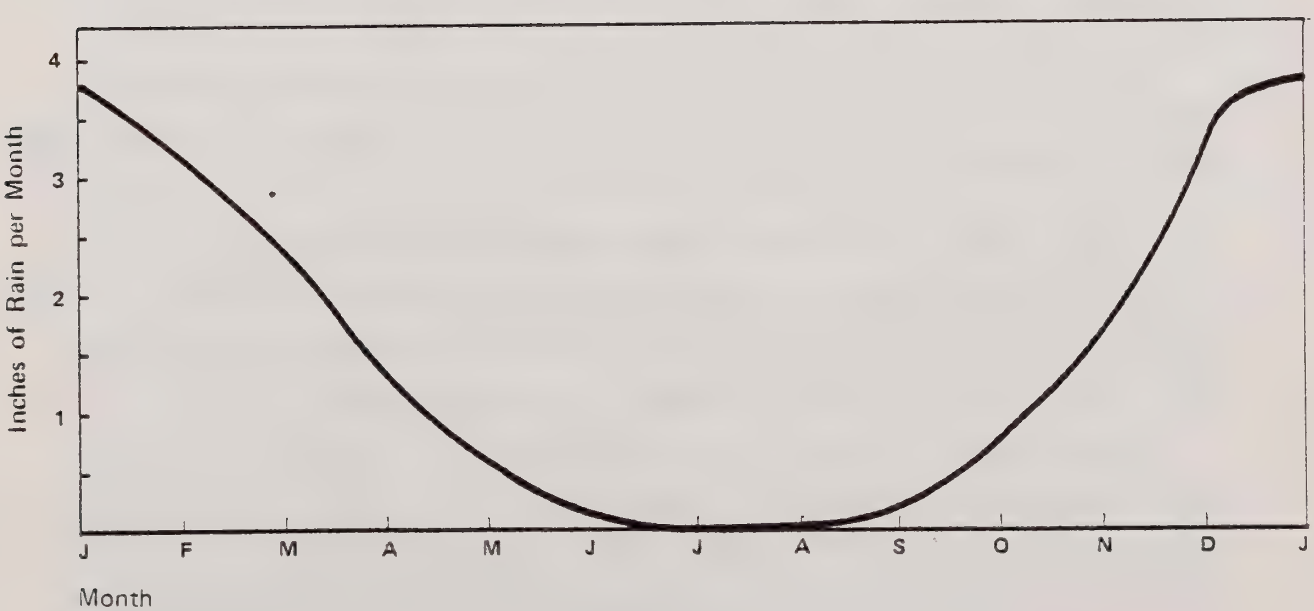


Figure 12. TEMPERATURES AND PRECIPITATION AT OAKLAND AIRPORT

annual rainfall at the project area is about 18 in. The average monthly temperatures range from about 46°F in January to about 66°F in September. Periods of low temperatures are confined to a few months, while higher temperatures may last for about six months. The extreme temperatures recorded in 1975 (at the San Francisco International Airport weather station) were from 30°F in January to 94°F in May. The normal daily temperature range is usually within 20°F; the temperature may vary 10°F above or below the daily average.

The closest air quality monitoring station to the project site is at the Oakland Airport, about 5 miles southwest. The California Air Resources Board operates this station in conjunction with the Bay Area Air Pollution Control District (BAAPCD). This station monitors only oxidants, carbon monoxide, and nitrogen dioxide. Concentrations of sulfur dioxide and suspended particulates measured in adjacent areas suggest that these pollutants do not exceed their standards in Oakland. Visibility restriction is noted at the Oakland Airport. It is expected that the air quality measured at the Oakland station is similar to, but possibly poorer than, the air quality along the pipeline route. This is because of greater vehicular activity in the station vicinity.

It is reported that these pollutants only occasionally exceed the applicable short-term standards. The existing air quality in the Oakland area has therefore been termed "moderate."

Table 2 shows the number of days per month that state air quality standards were exceeded in Oakland and nine county districts from December 1974 through November 1975. The only standards exceeded were the one-hour oxidant standards during the summer months.

Figure 13(a) and 13(b) show average monthly concentrations of NO_2 and NO respectively, from 1971 through 1975. No trends can be seen for NO_2 concentrations, but the annual means are all below the applicable standard of 0.25 ppm. Yearly trends are difficult to detect because of

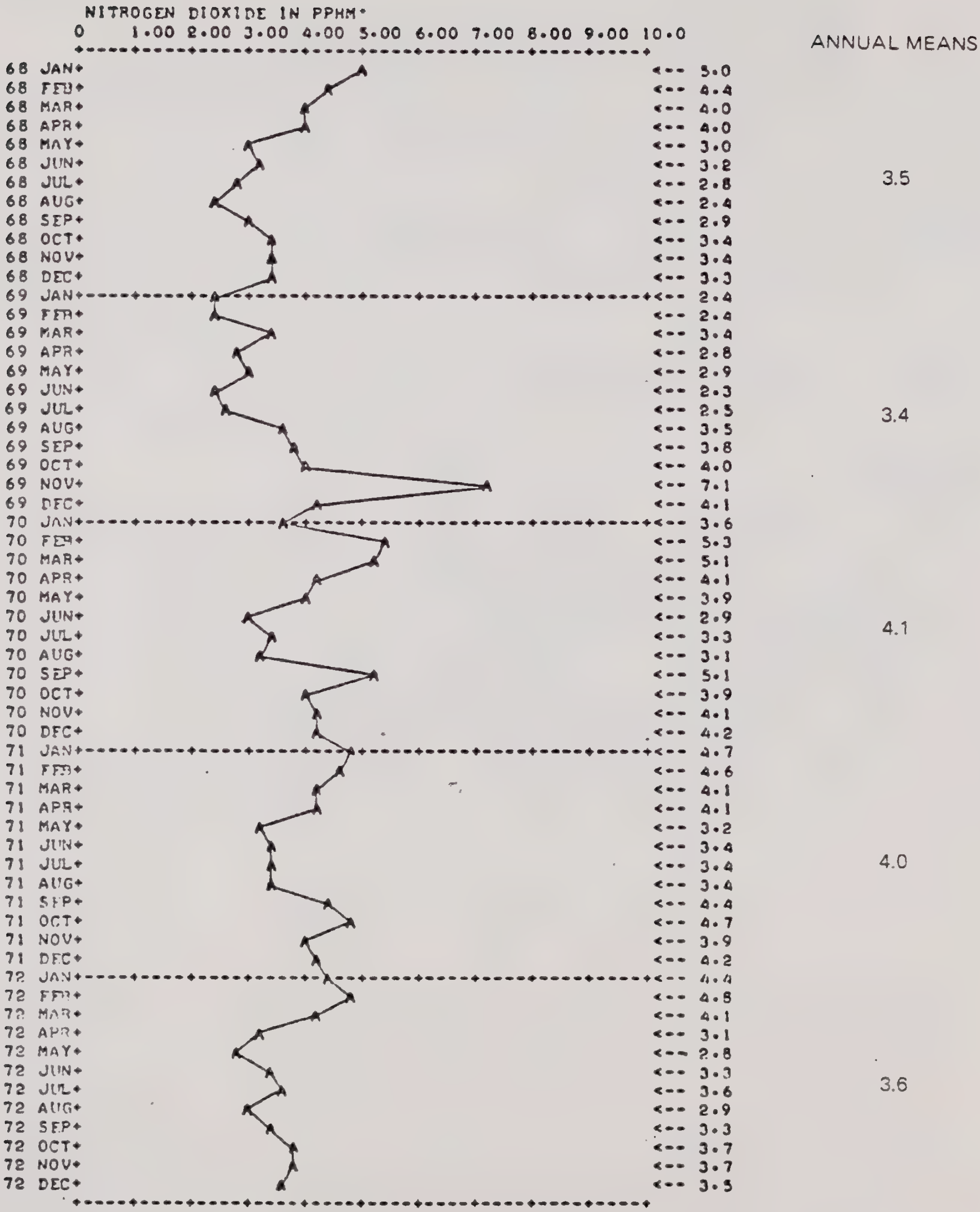
Table 2. NUMBER OF DAYS STATE AIR QUALITY STANDARDS* WERE EXCEEDED FROM DECEMBER 1974 THROUGH NOVEMBER 1975

	D	J	F	M	A	M	J	J	A	S	O	N
O_x												
Oakland	0	0	0	0	0	2	0	0	0	1	0	0
District	0	2	3	4	4	14	15	9	11	13	4	2
CO												
Oakland	0	0	0	0	0	0	0	0	0	0	0	1
District	4	9	1	0	0	0	0	0	0	2	1	8
Visibility restriction**												
Oakland	11	14	3	0	4	9	7	6	7	12	5	4

*Oxidant (O_x): >0.08 ppm for 1 hr
Carbon Monoxide (CO): 35 ppm for 1 hr or 9 ppm for 8 hrs
Nitrogen Dioxide (NO_2): 0.25 ppm for 1 hr

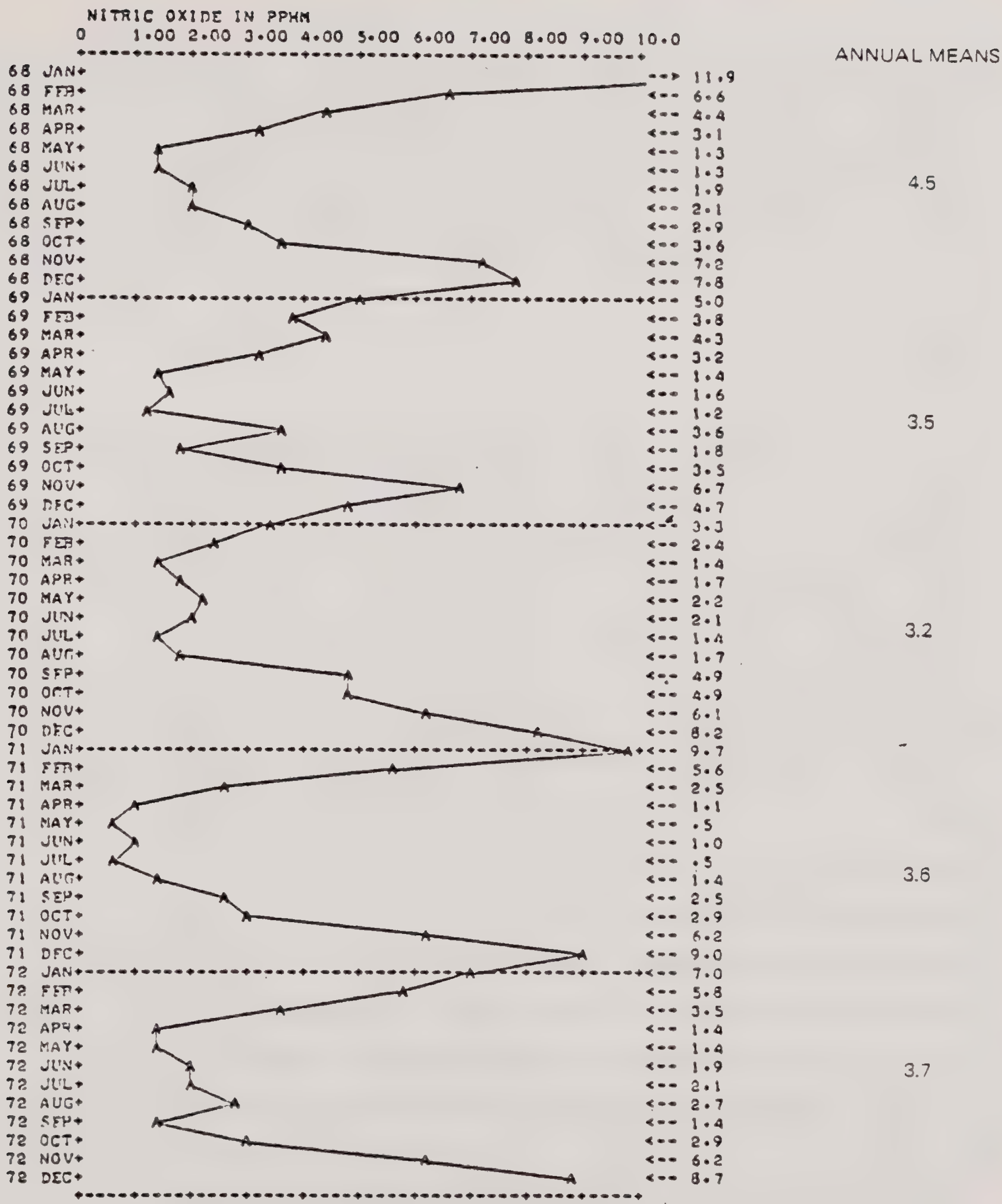
**Less than 10 miles when relative humidity >70%

Source: BAAPCD, 1975 (Meteorological and Construction Summaries)



SOURCE: BAAPCD, Technical Bulletin August 22, 1973
*(PPHM = parts per hundred million, by weight)

Figure 13(a). MONTHLY AVERAGES OF NITROGEN DIOXIDE CONCENTRATIONS IN OAKLAND, CALIFORNIA, FOR YEARS 1968 to 1972



SOURCE: BAAPCD, Technical Bulletin August 22, 1973

Figure 13(b). MONTHLY AVERAGES OF NITRIC OXIDE CONCENTRATIONS IN OAKLAND, CALIFORNIA, FOR YEARS 1968 to 1972

the many factors that influence concentration. The two major factors are emissions and meteorological elements. If emissions are reduced, concentrations may not go down if prevailing meteorological conditions restrict dispersion. Concentrations are highest during winter months when more fuel is consumed, while summer concentrations are low.

NOISE

Noise measurements were made along the proposed pipeline route to obtain a general indication of project site noise conditions. The measurements were made during a weekday morning. In the park at the upper end of the route, the noise levels were low. The noise level at the proposed location of the new valve box was about 50 dBA,* which increased to 60 dBA when trucks passed on the adjacent Warren Freeway. Generally, the prevailing noise sources were birds, the creek, and the freeway. Closer to the freeway, at the old valve box location and along Monterey Boulevard, noise levels were about 60 to 65 dBA. Occasionally, trucks pulling up the grade increased the noise levels to above 80 dBA. At the upper end of Lincoln Boulevard, normal traffic produced noise levels up to 65 dBA, but trucks going uphill were as noisy as 95 dBA. At Lincoln Avenue and Carmel Street the noise levels were low because of lower traffic volumes and milder grades. Without any autos, the noise level was in the low 40's, but with traffic it increased to 80 dBA. Near intersections and traffic, the noise levels increased to about 60 or 65 dBA.

Generally, the major noise source along the pipeline route was truck and automobile traffic. Noise levels ranged from 40 to 45 dBA under no-traffic conditions to 80 to 95 dBA with trucks traveling up grade. Along the freeway, the general noise levels were 60 to 65 dBA and occasionally 80 dBA.

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*dBA refers to the "A-weighted" noise measurement scale, expressed in decibels.

Noise levels vary with the time of day, day of the week, and, possibly, season. Usually, nighttime noise levels are lower. No specific limits are prescribed on noise levels by the City of Oakland's municipal code noise ordinance section (3-1.02). The only noise level restrictions pertain to nuisance-level disturbance during late evening and morning hours.

HYDROLOGY/WATER QUALITY

The proposed pipeline route lies near ridge crests for much of its distance. Surface water drains into several minor water courses. These drainage paths are described in Table 3 relative to pipeline segments, and are shown in Figure 14. Depth to groundwater is variable as reflected by soil stability studies conducted along the route by Woodward-Clyde and Associates (June 1970). The depth to groundwater fluctuated greatly from bore hole to bore hole, but none of the measurements showed the watertable to be close enough to the surface to interfere with installation or operation of the proposed pipeline.

From the proposed valve in Joaquin Miller Park (at the northeast end of the pipeline), the distance is approximately 50 ft to Palo Seco Creek. Palo Seco Creek, in turn, drains into Shepard Creek, which becomes Sausal Creek. Shepard and Sausal creeks flow year-round, while Palo Seco Creek may be dry during the summer months. This area is low and may occasionally flood. No water quality or flow data is available for Palo Seco Creek, or for any other creek in the area. The flows are expected to be quite variable, with maximum flows occurring from December through March, corresponding to peak rains. Water quality is probably best above developed areas and would degrade as street and yard runoff (and their associated pollutants) enter the creek.

Leaving the park, the route of the proposed pipeline rises, passes underneath Mountain Boulevard and the Warren Freeway, and turns up

Table 3. DESCRIPTION OF DRAINAGE ALONG THE PROPOSED PIPELINE ROUTE

Segments	Drainage
Joaquin Miller Park	Into Palo Seco Creek, passes beneath Mountain Boulevard and Warren Freeway through storm drains to join the main branch at Sausal Creek
Warren Freeway	Through storm drains to Palo Seco Creek
Monterey Boulevard	Through storm drains to Palo Seco Creek
Intersection	Through storm drains to the Whittle Avenue Branch of Sausal Creek
Lincoln Avenue	Through storm drains to the Whittle Avenue Branch of Sausal Creek
Carmel Street	Into storm drains on Lincoln Avenue to the Whittle Avenue Branch of Sausal Creek; Laguna Avenue, Rhoda Avenue, and Coolidge Avenue into storm drains to Peralta Creek
Maple Avenue	Through storm drains to Peralta Creek

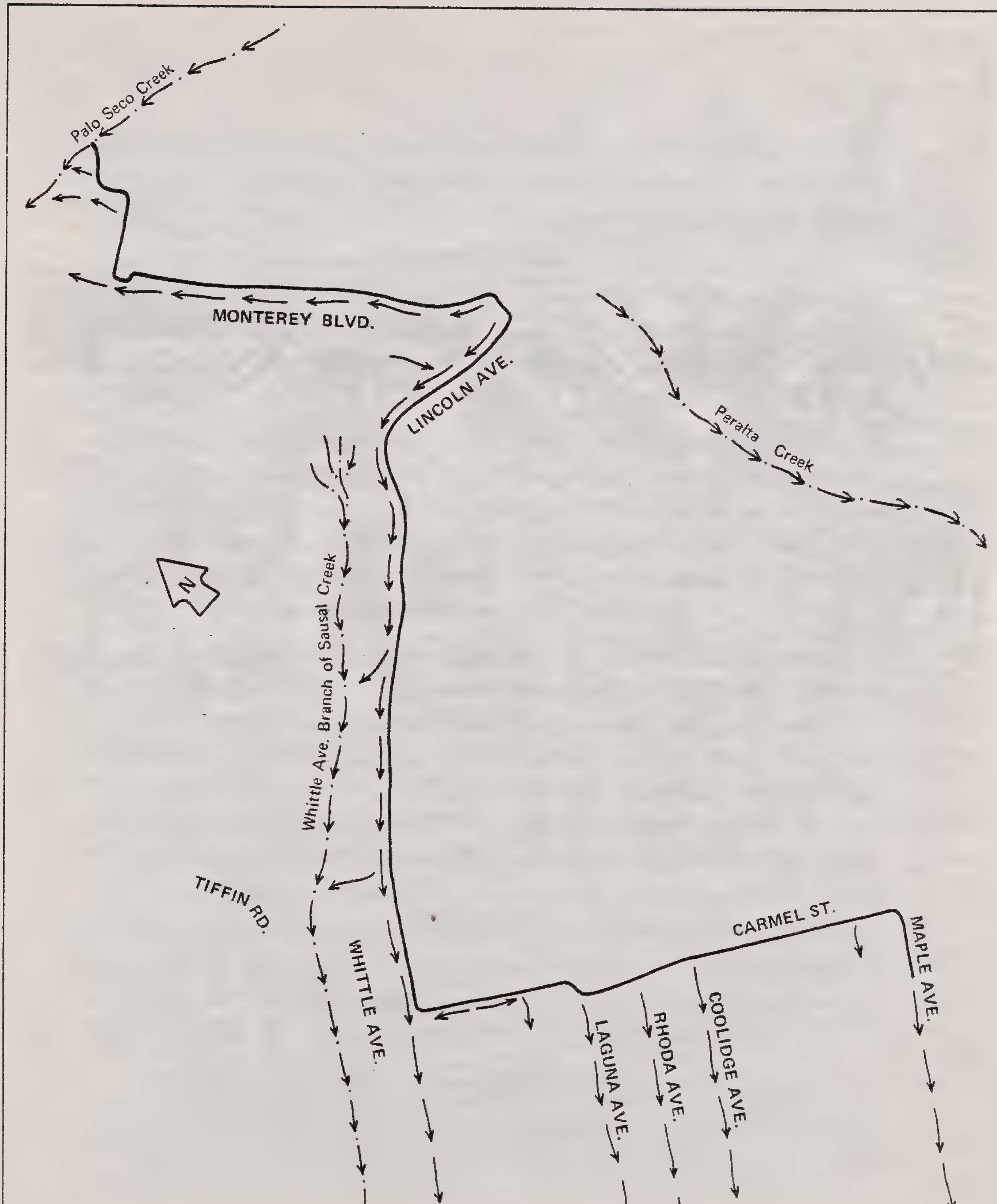

Figure 14. PROJECT AREA MAP SHOWING SURFACE DRAINAGE PATTERNS

Monterey Boulevard to the southeast. From this point on, the pipeline route is drained by city storm drains. These storm drains usually discharge into adjacent creeks.

Along Lincoln Avenue, surface drainage flows to the southwest in the Sausal Creek drainage basin, via the Whittle Avenue Branch. Curbside catchbasins collect the runoff from Lincoln Avenue at a minimum of one per block. In the steep upper sections, catchbasins are more closely spaced.

At Carmel Street the pipeline route turns to the southeast. On Carmel between Lincoln and Laguna avenues, the general drainage is split between Sausal and Peralta creeks. The upper reaches of Peralta Creek show evidence of extensive erosion; the solids content of the creek during heavy rainfalls is expected to be great. Maple Avenue runoff is directed to the Peralta Creek drainage basin.

The Sausal Creek watershed is about 2200 acres with about 1300 acres downslope from the pipeline route. The Peralta Creek watershed is about 1600 acres with about 1000 acres downslope from the pipeline. The typical "yearly maximum rainfall" that would occur in the project area is about one inch per hour, lasting for one hour. The pipeline would be about 30 ft above Peralta Creek at its lower end and is expected to be safe from flooding. The valve box which would be located in the canyon would be about 10 ft above the streambed of Sausal Creek, but the valve mechanism has been designed to be safe from significant impacts by floodwaters.

BIOLOGY/ECOLOGY

The majority of the proposed pipeline construction would take place on established roads in primarily residential and institutional areas. Most of the areas adjacent to the pipeline route retain few

vestiges of the original natural environment (i.e., before disturbance by man over the past several decades), with the exception of the section of pipeline located in Joaquin Miller Park.

The following is a description of vegetation and wildlife in Joaquin Miller Park and the urban areas adjacent to the proposed pipeline route.

Vegetation

Vegetation occurring in the park near the pipeline route includes a mix of species common to both coniferous and hardwood forests in the San Francisco Bay Region. Coastal redwood, Monterey pine, and Gowan cypress predominate. California laurel and coast live oak, both broad-leaved evergreen trees, occur as understory in association with the conifers. Examples of these are listed in Table 4.

Other understory vegetation is comprised of a variety of shade-tolerant forbs, herbs, and shrubs typical to coniferous and hardwood forests. Dominant plants in the understory appear to be California nightshade and French broom. Two coast redwoods and a stand of Stanford manzanita are located immediately adjacent to the existing shut-off valve at the entrance to Sequoia Lodge on the east side of the Warren Freeway. The redwoods appear to be relatively young trees and are approximately 20 to 30 ft tall.

In the vicinity of the pipeline crossing, the Warren Freeway and both Mountain and Monterey boulevards are landscaped with shrubs such as California redbud, blackwood acacia, and Christmasberry, and trees such as coastal redwood, California laurel, and Monterey pine.

Vegetation on the west side of Monterey Boulevard, in the general vicinity of the pipeline crossing, is similar to the vegetation found in Joaquin Miller Park with the addition of a few American elms. Eucalyptus, sweetgum, and Christmasberry are found along Lincoln Avenue.

Table 4. SPECIES LIST OF VEGETATION OBSERVED OR EXPECTED TO OCCUR IN THE PROJECT AREA

Common Name		Genus and Species	Family
Sword fern		*Polystichum munitum*	Aspidiaceae
Monterey pine		*Pinus radiata*	Pinaceae
Coast redwood		*Sequoia sempervirens*	Taxodiaceae
Gowen cypress		*Cupressus goveniana*	Cupressaceae
California laurel		*Umbellularia californica*	Lauraceae
Stanford manzanita	*cf.*	*Arctostaphylos stanfordiana*	Ericaceae
Small-flowered nightshade		*Solanum nodiflorum*	Solanaceae
California blackberry		*Rubus vitifolius*	Rosaceae
Christmasberry		*Photinia arbutifolia*	
French broom		*Cytisus monspessulanus*	Leguminosae
California redbud		*Ceris occidentalis*	
Blackwood acacia		*Acacia melanoxylon*	
Coast live oak		*Quercus agrifolia*	Fagaceae
American elm		*Ulmus americana*	Ulmaceae
Eucalyptus		*Eucalyptus spp.*	Myrtaceae
Sweetgum		*Liquidambar styraciflua*	Hamamelidaceae

Sources:

Brockman, C. F. 1968. *Trees of North America.* New York: Golden Press.

Munz, P.A. 1959. *A California Flora.* Berkeley: University of California Press.

Smith, A.C. 1959. *Introduction to the Natural History of the San Francisco Bay Region.* Berkeley: University of California Press.

Along Carmel Street, between Lincoln Avenue and Laguna Avenue, rows of sweetgum line both sides of the street. From Laguna Avenue to Maple Avenue, vegetation consists of variable residential landscaping.

Wildlife

Wildlife occurring near Joaquin Miller Park consists of a variety of species common to the Berkeley Hills region. Common mammal species that may inhabit areas adjacent to the pipeline route are listed in Table 5. Wildlife common to coniferous and hardwood forests, such as in Joaquin Miller Park, include the red squirrel, dusky-footed wood rat, western gray squirrel, and house mouse. Typical larger mammals may include gray fox, striped skunk, mule deer, and possibly a limited number of bobcat and coyote. Species common to the riparian habitat, as found near Palo Seco Creek, include the California vole, raccoon, California newt, and western pond turtles. See Table 6 for listing of reptiles and amphibians.

The dense vegetation of Joaquin Miller Park affords extensive avian habitat, and supports many birds common to the area, such as the winter wren, Hutton's vireo, white-breasted nuthatch, black-headed grosbeak, Steller's jay, pygmy nuthatch, robin, chipping sparrow, and several cosmopolitan species such as the house finch and English sparrow. (Table 7 lists typical bird species.) Most of these birds would be expected to inhabit the residential areas adjacent to the pipeline route. However, due to the lack of dense vegetation for food and cover, these populations would occur only in scattered areas.

Three rare and endangered species have been identified in other parts of Oakland which are at least somewhat similar to portions of the proposed pipeline route. These are Western leatherwood (a rare shrub associated with mixed chaparral and oak woodland communities),

Table 5. SPECIES LIST OF MAMMALS EXPECTED TO OCCUR IN THE PROJECT AREA

Common Name	Genus and Species	Family
Raccoon	*Procyon lotor*	Procyonidae
Striped skunk	*Mephitis mephitis*	Mustelidae
Coyote	*Canis latrous*	Canidae
Gray fox	*Urocyon cinereoargenteus*	
Bobcat	*Lynx rufus*	Felidae
California ground squirrel	*Citellus beecheyi*	Sciuridae
Western gray squirrel	*Sciurus griseus*	
Red squirrel	*Tamiasciurus hudsonicus*	
California vole	*Microtus californicus*	Cricetidae
Norway rat	*Rattus norvegicus*	Muridae
House mouse	*Mus musculus*	
Blacktail jackrabbit	*Lepus californicus*	Leporidae
Mule deer	*Odocoileus hemionus*	Cervidae

Sources:

Brown, V., and D. Hoover. 1967. *California Wildlife Map Book.* Healdsburg, California: Naturegraph Publishers.

Burt, W. H., and R. P. Grossenheider. 1964. *A Field Guide to the Mammals.* Boston: Houghton Mifflin Company.

Smith, A. C. 1959. *Introduction to the Natural History of the San Francisco Bay Region.* Berkeley: University of California Press.

Table 6. SPECIES LIST OF REPTILES AND AMPHIBIANS EXPECTED TO OCCUR IN THE PROJECT AREA

Common Name	Genus and Species	Family
California newt	*Taricha torosa*	Salamandridae
Black salamander	*Aneides lugubris*	Plethodontidae
Pacific treefrog	*Hyla regilla*	Hylidae
Bullfrog	*Rana catesbeiana*	Ranidae
Western pond turtle	*Clemmys marmorata*	Chelydridae
Gopher snake	*Pituophis melanoleucus*	Colubridae
Common garter snake	*Thamnophis sirtalis*	

Sources:

Smith, A.C. 1968. *Introduction to the Natural History of the San Francisco Bay Region*. Berkeley: University of California Press.

Stebbins, R.C. 1971. *Reptiles and Amphibians of the San Francisco Bay Region*. Berkeley: University of California Press.

———. 1966. *A Field Guide to Western Reptiles and Amphibians*. Boston: Houghton Mifflin Company.

Table 7. SPECIES LIST OF BIRDS EXPECTED TO OCCUR IN THE PROJECT AREA

Common Name	Genus and Species	Family
Steller's jay	*Cyanocitta stelleri*	Corvidae
White-breasted nuthatch	*Sitta carolinensis*	Sittidae
Pigmy nuthatch	*Sitta pygmaea*	
Winter wren	*Troglodytes troglodytes*	Troglodytidae
Robin	*Turdus migratorius*	Turdidae
Hutton vireo	*Vireo huttoni*	Vireonidae
English sparrow	*Passer domesticus*	Ploceidae
Black-headed grosbeak	*Pheucticus melanocephalus*	Fringillidae
House finch	*Carpodacus mexicanus*	
Chipping sparrow	*Spizella passerina*	

Sources:

Brown, V., H. Weston, Jr., and J. Buzell. 1973. *Handbook of California Birds*. Healdsburg, California: Naturegraph.

Cooper Ornithological Club. 1927. *Directory to the Bird Life of San Francisco Bay Region*. Berkeley, California: J. Grinnell and M. W. Wythe.

Peterson, R. T. 1969. *A Field Guide to Western Birds*. Boston: Houghton Mifflin Company.

a rare form of manzanita, and the Alameda striped racer (a snake associated with chaparral communities). None of these have been identified along the route nor would the proposed project have a significant effect on them.

SOCIOECONOMIC CONSIDERATIONS

Housing statistics for the census tracts along the proposed pipeline route indicate a characteristic middle class neighborhood primarily composed of single-family dwellings. The route would pass through Census Tracts 4046, 4047, 4048, and 4067 (see Figure 7). Census Tracts 4048 and 4067 have a substantial number of multiple family dwellings. The only multiple family dwellings found immediately adjacent to the pipeline route are on Carmel Street in Census Tract 4067. Visual inspection of the residences along the pipeline shows older, well-established neighborhoods where houses and apartments are kept in good repair. The number of houses adjacent to each segment of the pipeline route is given in Table 8.

The northern end of the proposed pipeline lies in Joaquin Miller Park. In addition to the hiking opportunities offered by the trail system, the City of Oakland Department of Recreation operates Sequoia Lodge (located off Mountain Boulevard). During the week, the Sequoia Nursery School uses the Lodge from 8:30 a.m. to 12:30 p.m. Meetings and social engagements are held there evenings.

On the remainder of the pipeline route there are several church and school facilities. The California central headquarters of the Church of Jesus Christ of the Latter Day Saints occupies a large house on Monterey Boulevard. A large paved parking lot is located adjacent to the church headquarters.

Table 8. NUMBER OF DWELLINGS ADJACENT TO PIPELINE SEGMENTS

Pipeline Segment	Single-Family Houses	Multiple-Family Dwellings
Joaquin Miller Park	6	0
Warren Freeway	0	0
Monterey Boulevard	18	0
Monterey/Lincoln Intersection	1	0
Lincoln Avenue	54	9
Carmel Street	45	29
Maple Avenue	6	0
Total	130	38

The Mormon Temple is located directly across Lincoln Avenue from this parking lot. These church facilities, including a visitors' center, are in constant use. Tuesday through Saturday, an estimated 500 to 1000 persons visit the temple per day. Tuesday and Wednesday evenings, 50 to 150 young people gather at the Temple. Other groups use the church's athletic and social facilities for special events.

Immediately down the hill from the Mormon Temple is the Greek Orthodox Church and its adjacent parking facilities. Next to the church parking lot is the Cerebral Palsy Center which houses the Bay Area's main office and its recreation program headquarters. Below this is the Lincoln Child Center, which offers 24-hour treatment for emotionally disturbed children and a day treatment center for boys. Across the street from the Lincoln Child Center is the small private horse ranch described previously.

Downhill from the Lincoln Child Center is the Head-Royce School, a private coeducational day school with facilities on both sides of Lincoln Avenue. Total school enrollment is about 550 students, in kindergarden through 12th grade. Pedestrian traffic across Lincoln Avenue is high when students change classes. The school is serviced Monday through Friday in the morning and afternoon by their own school buses.

The land use on Carmel Street and Maple Avenue is strictly residential with the exception of a small neighborhood market located near the intersection of Carmel Street and Maple Avenue.

The pipeline route passes through Census Tracts 4046, 4047, 4048, and 4067 (see Figure 7). Census statistics (1970) for these tracts and for Oakland as a whole are given in Table 9. Although changes have occurred over the past six years, population has probably remained nearly constant in these comparatively stable neighborhoods. Figures for incomes and the mean value of housing have obviously increased sharply due to inflation.

Table 9. 1970 CENSUS STATISTICS

	Census Tracts 4046	4047	4048	4067	Oakland
Total Population	3594	2055	2784	5099	361,561
% Population under 18	31.8	23.5	20.4	21.6	27.4
Civilian Labor force	1081	570	770	1457	94,106
% unemployed	2.2	3.4	4.5	4.8	7.8
Family incomes					
Median $	18,906	15,208	12,082	12,127	9,626
Mean $	20,700	17,602	13,211	14,050	11,279
Owner-occupied housing*	1050	646	575	1390	51,339
Mean value $	38,700	33,800	24,100	23,000	21,300
Renter-occupied housing**	101	70	583	554	79,631
All year-round housing units	1173	736	1246	2056	146,603
Occupied housing units	1156	727	1215	2015	138,826
Units in structure:					
1***	1136	694	722	1763	71,769
2	10	26	54	60	13,942
3 and 4	7	8	160	177	17,157
5 to 49	20	0	318	66	37,133
50 or more	0	0	0	0	6,602

*Limited to one-family homes on less than 10 acres and no business on property.

**Excludes one-family homes on 10 acres or more.

***Including trailers and mobile homes.

Source: General Census, 1970, Census Tract Data PHC (1)-189, Bureau of the Census, United States Department of Commerce.

Only a small portion of the pipeline would pass through Census Tract 4046. This is the section within Joaquin Miller Park, and the only residences near the pipeline are located on Joaquin Miller Court. There is a high percentage of people under 18 when compared to the other census tracts along the pipeline route or to the city of Oakland in general. People who live in Census Tract 4046 enjoy higher mean and median family incomes, a very low percentage of unemployment, and live in owner-occupied housing that is almost twice as valuable as the average owner-occupied housing in Oakland.

The statistics reported for Census Tracts 4047, 4048, and 4067 appear to be more representative of the socioeconomic conditions along the proposed pipeline route. Housing values and both median and mean family income levels are lower than for Census Tract 4046, but they remain average or above average when compared to the city of Oakland. Unemployment percentages are beneath the average level reported for Oakland. These census data suggest that these tracts encompass upper-middle and middle income neighborhoods.

TRANSPORTATION

Vehicular Traffic

Recent traffic counts made by the City of Oakland Department of Public Works are shown in Table 10. The approximate locations of these traffic counts are shown in Figure 15. Peak hour traffic on these streets is approximately ten percent of the daily count.

Mountain Boulevard carries 3675 vehicles per day and is not considered heavily travelled. The Warren Freeway is a major north-south freeway and carries around 39,000 vehicles per day. During the peak hours it carries around 4000 vehicles per hour. The proposed pipeline would tunnel under these streets, causing no disruption of traffic.

Table 10. RECENT TRAFFIC COUNTS IN THE PROPOSED PIPELINE AREA

Thoroughfare	Location of Count	No. of Traffic Lanes	Actual Traffic (Vehicles/Day)	Design Capacity (Vehicles/Day)
Mountain Blvd.	North of Joaquin Miller Rd.	2	3,675	10,000
Warren Freeway	At Lincoln Avenue Overpass	4	39,000	80,000
Monterey Blvd.	North of Lincoln Avenue	2	3,790	10,000
Lincoln Ave.	At Warren Freeway	2	5,710	10,000
	At MacArthur Freeway	2	6,155	10,000
Carmel Street	*	2	*	10,000
Maple Avenue	At Carmel Street	2	1,800**	10,000
Maple Avenue	At MacArthur	2	3,150	10,000

Sources: City of Oakland Traffic Engineering and Parking Department and California Department of Transportation.

*No traffic count is available.

**Based on a count of 3150 vehicles per day near the MacArthur Freeway. The estimated figure of 1800 is considered high but representative.

Figure 15. LOCATION OF RECENT TRAFFIC COUNTS AND PUBLIC TRANSIT ROUTES

Monterey Boulevard serves as an exit route from the Warren Freeway southbound. This exit feeds cars into the intersection of Monterey Boulevard and Lincoln Avenue. The traffic on Monterey Boulevard is moderate. Lincoln Avenue, including the intersection with Monterey Boulevard, normally carries heavy traffic and as a result has been designated a "Limited Operations Area" for construction activities.* According to City Ordinance, construction may not be undertaken during the peak traffic periods of 7 to 9 a.m. and 4 to 6 p.m. This means that no work or equipment and materials storage that interferes with normal traffic flow would be permitted during peak periods unless specifically approved by the City Engineer.

Carmel Street serves as the local north-south artery in this neighborhood, as the other streets do not connect Lincoln and Maple avenues. Traffic on Carmel Street is generally automobile and service trucks travelling to and from residences. Traffic on Maple Avenue is light; it serves as a collector rather than a through street.

<u>Public Transit</u>

AC Transit District operates two bus routes, "15a" and "18", along the proposed pipeline route. "53" passes near the proposed pipeline route but does not cross it. The busline routes are described below. Their locations relative to the proposed pipeline route are shown in Figure 15.

Route "15a" originates at the Berkeley Loop Terminal and runs to downtown Oakland, East Oakland, and then turns from MacArthur, up Coolidge Avenue. It crosses the proposed pipeline at Carmel Street, continues up Coolidge to Alida Street, and crosses the proposed pipeline

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*Telephone communication with Mr. O'Boyle, City of Oakland Traffic and Engineering and Parking Department. See also p. 5 of *Manual for Construction Traffic Control,* City of Oakland, Traffic Engineering and Parking Department, September 1973.

route again where Alida Street intersects Lincoln Avenue. On Lincoln Avenue, route "15a" parallels the proposed pipeline route up to the intersection of Lincoln Avenue and Monterey Boulevard. At this point, Route "15a" continues via Joaquin Miller Road to Skyline Boulevard on school days and to Brook Park Drive on school holidays. (Some trips terminate at Mountain Boulevard and Joaquin Miller Road.) Busses return on the same route.

Busses on route "15a" run Monday through Friday 7:00 a.m. to 6:40 p.m., and Saturday 7:30 a.m. to 7:00 p.m., approximately every one-half hour. On Sundays and holidays busses operate from 7:00 a.m. to approximately 6:30 p.m. and run at regular 40-90 minute intervals.

Route "18" originates at the Oakland 19th Street station and runs to downtown Oakland, East Oakland and then continues up Park Boulevard to Leimert Boulevard, where it crosses the proposed pipeline route near the corner of Monterey and Leimert Boulevards. On Monterey Boulevard, route "18" parallels the proposed pipeline route to the intersection of Monterey Boulevard and Lincoln Avenue. At this point route "18" crosses the Warren Freeway on Lincoln Avenue and turns left onto Mountain Boulevard, crossing the proposed pipeline route again near the entrance to Sequoia Lodge. Route "18" makes two loops in the Piedmont Pines and Montclair neighborhoods before heading back to downtown Oakland on Park Avenue. Busses run Monday through Friday from 6:40 a.m. to 6:10 p.m. There is no service on weekends or holidays.

HISTORICAL/ARCHAEOLOGICAL RESOURCES

There are no known archaeological or historical sites of interest along the pipeline route; however, the archaelogical consultants (Holman and Chavez) indicate that there is the potential for some surface remains to be found (a letter report is on file with the City).

Section IV

ENVIRONMENTAL IMPACTS

The environmental impacts expected to occur as a result of building and operating the proposed relocated products pipeline are discussed in this section. Note that the following discussion covers only those impacts which would occur as a result of normal construction and operation. It does not consider what could occur as a result of accidents or vandalism. Because the proposed pipeline would carry flammable products through an area of residences, schools, and other institutions, the potential effects of accidents are discussed separately (in Section B).

The principal impacts would be temporary and would occur only while the proposed pipeline is being constructed. The techniques of construction and their effects are discussed in the following paragraphs, with emphasis on the human environment. The impacts are described in terms of the following subject areas:

- land use
- topography
- meteorology/air quality
- noise
- hydrology/water quality
- biology/ecology
- socioeconomic considerations
- transportation
- historical/archaeological resources

Those adverse environmental impacts which appear to be unavoidable are discussed in Section V. Subsequent sections deal with mitigating measures, the relationship between local short-term uses and long-term productivity, irreversible changes and resource commitments, anticipated growth-inducing effects, and alternatives to the proposed project.

LAND USE

The project should cause no significant impact on existing land use patterns or major natural features such as landscape, water drainage patterns, unique geologic features, or biologic features.

The proposed pipeline would run beneath existing roads for its entire length. The Warren Freeway would be tunneled under, with the remainder of the route being trenched.

TOPOGRAPHY

Placement of the proposed pipeline would cause some temporary changes in local-scale topography, but these changes would last only for the duration of the construction period.

With the exception of the segment passing through Joaquin Miller Park, all construction would be within existing city streets. The paved surfaces of streets would be restored to original grade and surface condition at the completion of construction.

A slight modification of the land surface would be necessary at the new park valve location in Joaquin Miller Park. A 20 ft x 20 ft area would be excavated and levelled to accommodate the 9 ft x 11 ft x 8 ft concrete vault. Remaining portions of the pipeline would be restored to preconstruction conditions.

Construction of the proposed pipeline is expected to take approximately 100 working days to complete the project. This figure is based

upon 120 ft of completed line per working day. It would take two days to complete one 120-ft section of line, and it is anticipated that 240 ft of ditch would be open at all times. The time it takes to complete a section would depend upon the difficulties encountered, both in actual construction and in maintaining the flow of traffic. The trench for the pipeline would be deep enough to provide the required minimum cover of 3 ft over the casing and 4 ft over the pipeline (where it is buried directly). The pipeline would pass beneath buried utilities unless they were at a depth that would permit 3 ft of cover with the pipeline passing over them. All underground utilities and their appurtenances would be located and excavated by hand prior to mechanical trenching.

The amount of road surface affected would depend upon the design criteria for a given segment (refer to Figure 16). The proposed pipeline would cross two separate fault zones, one zone twice. In these sections, the carrier pipe would be placed in either a concrete or a steel casing. The addition of the casing would require a larger trench than conventional burial, and as a consequence, would disturb a larger part of the road surface. A minimum of one lane would be maintained for traffic along the route with the exception of a two-block section of Carmel Street at Maple.

Construction of Segments with Casing

As mentioned above, the use of casing would increase the size of the required trench. On the average, the trench excavated for casings would be 8 ft wide and 8 ft deep. In addition to the trench, approximately 15 to 25 ft of the road surface would be devoted to work space during construction. Thus, there could be as much as 33 ft of roadway lost to vehicular flow where casing construction is employed. Figure 16(a) shows the proposed trench and casing geometry.

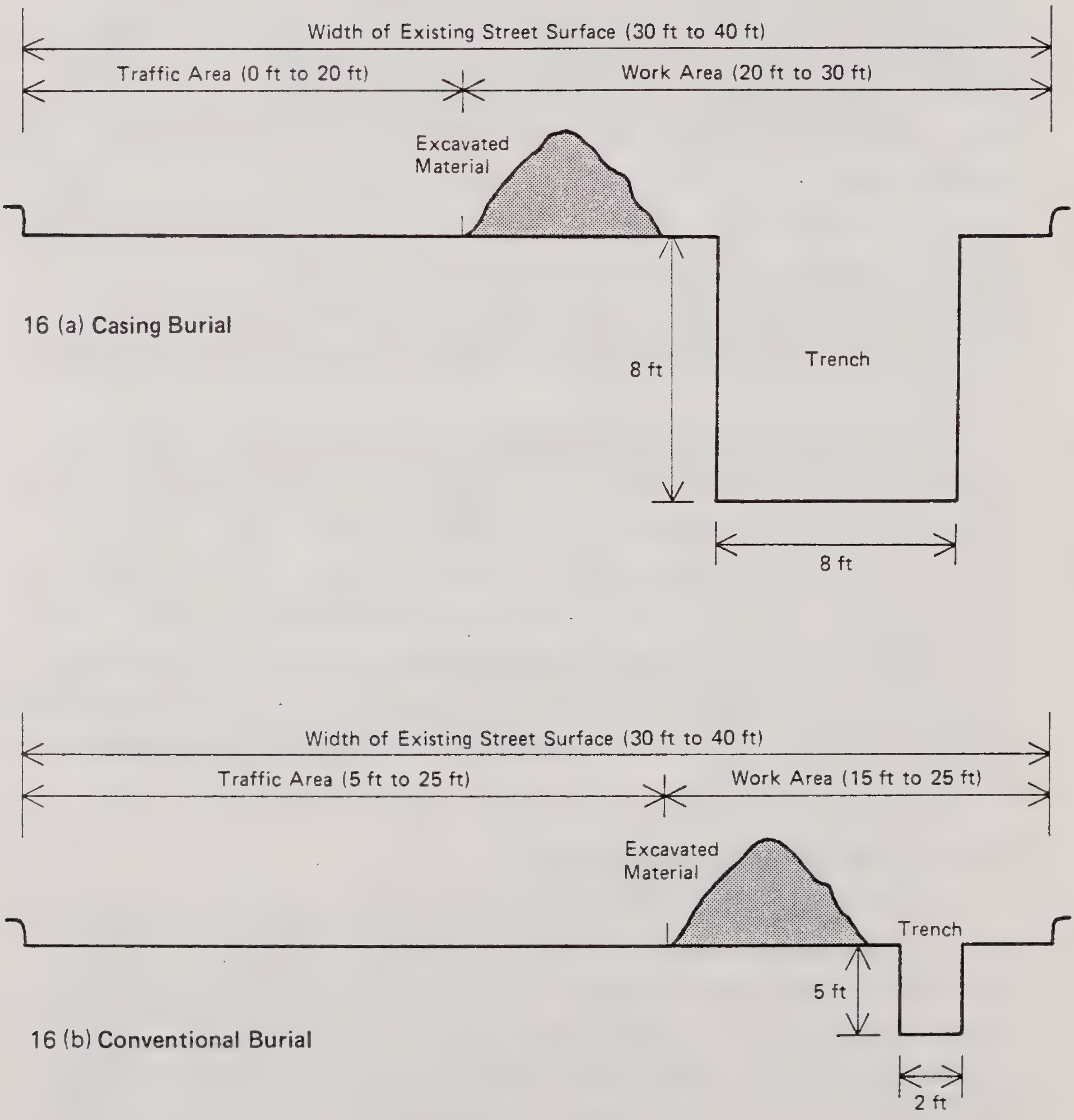

Figure 16. TYPICAL PIPELINE CONSTRUCTION CROSS SECTION

Based upon a projection of 120 ft of progress per working day, about 285 cu yds of spoil would be transported from the site per day. Translated into vehicular flow, this means a 15 cu yd dump truck would make nineteen trips per day at 25-minute intervals. The removal of spoil necessitates bringing in new backfill material.* Approximately 110 cu yds of new material would be required daily for backfill material. The removal of spoil, and the delivery of new backfill material would require a truck to complete one round trip every 20 minutes each working day. Additional truck traffic would occur as materials such as casing, pipe sections, and lean-concrete are delivered to the site.

Segments with Conventional Burial

Where the proposed pipeline does not cross a fault zone, conventional construction techniques would be employed. These techniques require less obstruction of roadway. The trench would be about 2 ft wide and vary in depth, with a 5 ft minimum. Trench depth would vary according to the depth of existing utilities. Working space would require 15 to 25 ft in addition to trench width.

Based upon 120 ft of progress per working day, about 45 cu yds of spoil would be transported from the site per day. This removal would require a 15 cu yd dump truck to make three trips per day. As in the areas requiring casing, new backfill material would have to be brought in. This would require two 15 cu yd dump trucks to make two trips per day, transporting about 20 to 30 yds of material. The removal of spoil, and the delivery of new backfill material would require a truck to complete one round trip every 1.5 hr each working day. Additional truck traffic would be required to transport pipe to the work site.

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*There could be secondary impacts associated with the hauling and disposal of spoil and the procurement and hauling of fill. However, the nature and extent of these impacts depend strongly upon the location of the fill source and the dump site. These have not been designated as yet (they will probably be selected by the construction contractor).

METEOROLOGY/AIR QUALITY

No measurable climatic changes are expected to result from construction or operation of the proposed pipeline. The pipeline would be placed underground and would have no influence on wind movement. Most of the pipeline route is presently paved, so restoration of pavement following construction should not increase surface heating.

Air quality impacts associated with the proposed pipeline project would occur only during the construction phase. The petroleum products that will be delivered by the proposed pipeline are currently being delivered by an alternate pipeline, so no increase in fuel usage is expected to result from this project.

Minor air quality impacts would occur as a result of construction equipment and truck emissions, wind erosion of disturbed soil, and potentially increased automobile emissions due to congested traffic conditions. About 4 or 5 pieces of equipment would be at the construction site at any one time. These would include pavement breakers, rubber-tired and tracked backhoes, front-end loaders, and paving machines. All this equipment would not be operating at one time at a single location. It is expected that this equipment would be spaced over a construction segment approximatley 240 ft long. In addition, dump trucks would periodically remove spoil material and import new fill material. About 4 trucks per hour would pass through the site. The magnitude of these impacts are difficult to assess quantitatively, however; past monitoring of other construction projects gives a general indication of severity. The following discussion is based upon knowledge of conditions which have occurred on similar projects.

Expected air pollutant concentrations are shown in Table 11. Air pollutant concentrations for the proposed project may differ somewhat due to different soil, meteorological, and construction conditions.

However, this table indicates the range of increased concentrations that were observed for similar construction activities.

Table 11. ESTIMATED RANGES OF INCREASED SHORT-TERM POLLUTANT CONCENTRATIONS DUE TO CONSTRUCTION ACTIVITIES

	On-Site	1/4 mile downwind	1 mile downwind
Particulates			
suspended	40 to 300 $\mu g/m^3$	1 to 10 $\mu/g/m^3$	<1 to 3 $\mu g/m^3$
nuisance	300 to 2,000 $\mu g/m^3$	<10 $\mu g/m^3$	<10 $\mu g/m^3$
CO	1 to 13 ppm	<1 ppm	<1 ppm
NO_2	0.01 to 0.15 ppm	<0.01 to 0.05 ppm	<0.01 ppm

Note: 1 μg = one microgram
1 $\mu g/m^3$ = one one-millionth of a gram per cubic meter
1 ppm = one part per million, by weight

The expected increases reported in Table 12 would be temporary and would only occur during construction hours, with the possible exception of particulates. Construction activities are not expected to cause one-hour NO_2 standards to be exceeded, except near the site during periods when NO_2 concentrations are already high. Increased pollutant concentrations would affect only small areas. Similarly, the short-term CO standards would be exceeded only under extreme conditions, or if the ambient concentrations were already high. Again, the affected area would be limited to the immediate site vicinity. Onsite suspended particulate concentrations may exceed the applicable short-term standards near the site. This could be reduced by minimizing handling of dirt and minimizing exposed dirt. Nuisance particulates may create local buildup of dust on nearby property. These impacts would affect a single residence for a period of several days to several weeks.

Construction operations could cause some traffic congestion near the work sites. Flagmen and other traffic controls would keep this to a minimum. However, increased local air pollutant concentrations are likely, and short-term NO_2 and CO standards would be exceeded occasionally near construction areas.

Construction trucks would increase air pollutant emissions along their routes. However, the expected maximum of 4 trucks per hour would not result in significant increases in air pollutant concentrations.

NOISE

Noise impact resulting from the proposed pipeline project would be limited to the period of construction (approximately 100 days). This impact would result from onsite construction-equipment use, trucks, and increased traffic congestion. No noise is expected from operation of the pipeline.

Equipment noise has been estimated from the limited monitoring conducted along Lincoln Avenue in August 1974 (WCC) and from published reports of the EPA (1971). This monitoring included measurements of noise from pavement breakers, a motor grader (blade), a backhoe, a front-end loader, and trucks for underground construction by the telephone company. Another monitoring effort (conducted in Redwood City in August 1974 by WCC) included a Barber Greene paving machine, a roller, and asphalt trucks. The levels recorded for these activities are reported in Table 12. The activities monitored are similar to the proposed activities. Therefore, the noise levels reported in Table 13 should be similar.

Tables 13 and 14 are EPA reported noise levels that may be expected due to construction operations. The levels reported for excavation in Table 13 should be representative of the noise levels expected near the construction activities (except for material hauling). The range

Table 12. ESTIMATED NOISE LEVEL RESULTING FROM CONSTRUCTION OF PROPOSED PROJECT (Noise Levels in dBA)

Construction Activity	Outdoors at 50 ft	Indoors at 50 ft, doors open and windows shut*	Indoors at 50 ft, doors and windows shut*
Pavement breaking	86	70	65
Motor grader, working	84 (scraping asphalt)	68	63
Motor grader, idling	75	59	54
Backhoe and truck being loaded by front-end loader	85	69	64
Loaded truck going uphill	85 - 93	69 - 77	64 - 72
Paving machine, idling	60	45	40
Paving machine, loading	70	52	47
Paving machine, traveling	85	67	62
Roller	75	61	56

*Some of these values are estimates based on measurements and known sound attenuation rates.

Source: Woodward-Clyde Consultants.

Table 13. TYPICAL NOISE LEVELS DURING CONSTRUCTION OF PUBLIC WORKS, HIGHWAYS, ETC. (dBA at 50 ft)

	All Equipment at Site	Minimum Required Equipment at Site
Ground Clearing	84	84
Excavation	88	78
Foundations	88	88
Erection	79	78
Finishing	84	84

Source: EPA, 1971.

Table 14. TYPICAL NOISE LEVELS FOR CONSTRUCTION EQUIPMENT

Equipment	Level dBA at 50 ft
Compactors	72
Front Loaders	72-84
Backhoes	72-93
Tractors (dozers)	76-95
Graders	80-93
Pavers	87
Trucks	83-94
Concrete Mixers	75-87
Concrete Pumps	83
Cranes	75-87
Derricks	88
Pumps (Engine Op.)	70
Generators	72-82
Compressors	75-87
Pneumatic Wrencher	83-88
Jack Hammers	81-98
Impact Pile Drivers	95-106
Chain Saws	73-82

Source: EPA, 1971.

of noise levels shown (78 to 88dBA) encompasses the noise levels that were monitored by WCC. The noise due to truck operations reported in Table 12 can exceed this range. Table 14 presents EPA reported noise levels due to operation of a variety of construction equipment. Again, these values are close to those measured by WCC.

The noise levels shown in Tables 12 through 14 would occur only during normal working hours for limited durations. Construction would be limited to daylight hours.

HUD (December 1971) has established provisional criteria relating to community noise acceptability in residential areas. These criteria are shown in Table 15. As an example, if the noise levels were between 45 and 60 dBA 50% of the time, the noise levels would probably be considered nominally acceptable for routine long-term exposure. The construction noise due to the proposed project would occur for less than 33% of the day (8 hours in each 24 hours). Therefore, only the 10% and 50% occurrence criteria should be compared to the expected noise levels. The noise levels expected at the site, as shown on Table 12, are normally considered unacceptable outdoors at 50 ft. Some construction operations would produce unacceptable indoor noise levels, with doors and windows shut. Due to the rate of advance of the construction, an individual home would only be affected by construction noises for a few days. However, the truck noises would impact residents along some of the haul routes for several months. The area that will experience most of the truck haul noises (Lincoln Avenue) tend to be comparatively noisy at present and therefore the maximum noise level should remain approximately the same. The duration of these levels would increase; however, in the areas that are currently quiet (e.g., Carmel Street) the construction and haul noises would be greater than the current maximum levels, and the associated impact should be expected to be greater.

Traffic control near the construction areas may cause some increased vehicle idling and more vehicle accelerations. The idling is

Table 15. HUD RESIDENTIAL NOISE CRITERIA

Criteria	Acceptable noise levels (dBA) related to the percent of time the noise level is exceeded		
	90%	50%	10%
Clearly Acceptable	<41	<45	<53
Normally Acceptable	41 - 56	45 - 60	53 - 67
Normally Unacceptable	56 - 70	60 - 72	67 - 82
Clearly Unacceptable	>70	>72	>82

expected to be quieter than the normal traffic flows, but the increased number of vehicle accelerations would create more noise than usual. This noise may exceed 90 dBA for large trucks.

As a summary, Table 16 compares some of the expected noise levels due to the proposed construction activities with various human responses and typical noise sources. The overall range of construction noise expected would range from quiet to very annoying.

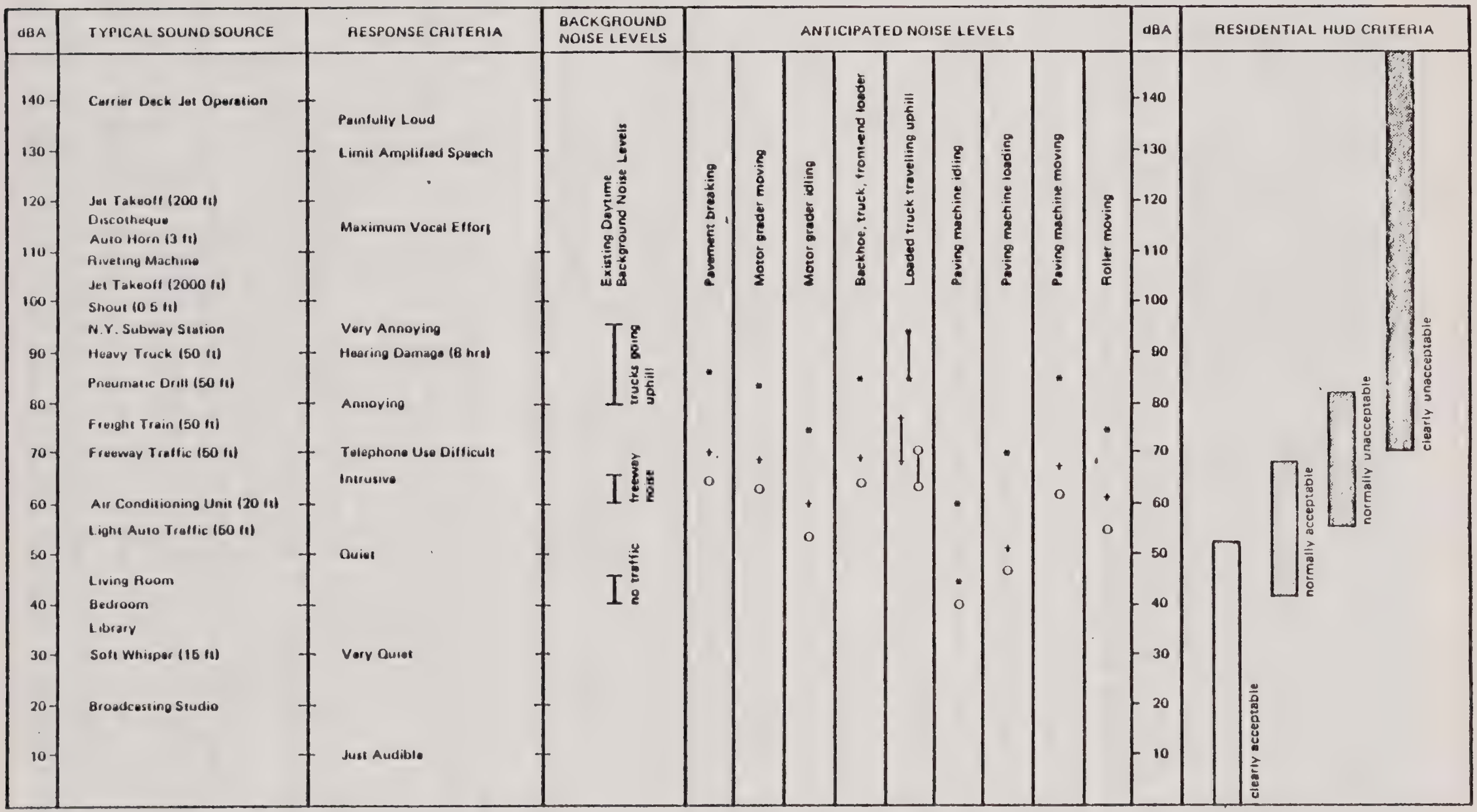
HYDROLOGY/WATER QUALITY

During construction, the potential for soil erosion in the Joaquin Miller Park section could be considerable. The 335 ft of pipeline in this section would follow an abandoned dirt road up a slight grade. A visual inspection of the proposed pipeline route revealed evidence of erosion along the abandoned road. If protective measures were not taken during trenching operations, the completed pipeline trench would be susceptible to erosion. The backfill material may not be as dense as the surrounding material, making it more susceptible to erosion and transport. These processes could introduce sediments into Palo Seco Creek and the storm sewers that transport creek waters.

If proper protective measures were employed, there would be no long-term impact on water quality in this section. An unusually large volume of water from heavy rains could introduce noticeable but insignificant amounts of sediments into the drainage system; however, this should occur for only a short period of time.

Effects on water quality for the 9265 ft of pipeline proposed to be built in existing roadways would be short-term, and would occur only during construction. Most of this section (9073 ft) would be trenched in surface roads, while a smaller segment (192 ft) would be bored under the Warren Freeway. The trench and spoil materials would be susceptible to erosional processes during construction unless protective measures

Table 16. SOUND LEVELS AND HUMAN RESPONSE COMPARED WITH ANTICIPATED CONSTRUCTION NOISE LEVELS



Key: * Outdoors at 50'
+ Indoors at 50', doors open, windows shut
O Indoors at 50', doors and windows shut

are taken. Surface runoff waters in construction areas would erode the spoil banks and transport them down gutters and storm sewers. It is unlikely that significant amounts of sediments would be transported because construction activity would expose 240 ft at one time, and the material to be excavated is rocky. Heavy rainstorms and resulting surface runoff may introduce sediments to storm sewers and deposit them in catch basins and sewer pipes.

The road surfaces would be repaired and assume their original condition upon completion. No alterations would be permanent; consequently, there would be no long-term effects on water quality and no increased surface runoff.

BIOLOGY/ECOLOGY

The proposed pipeline would cause minor biological impact, usually involving introduced plant and animal species. Biological impact would be more significant where the pipeline route traverses the relatively undisturbed area in Joaquin Miller Park. Excavation of the new underground valve vault in Joaquin Miller Park (shown in Figure 3) could eliminate several California blackberry shrubs.

Removal of vegetation would impact both the plants and animals in and around the area. Certain wildlife may avoid the general area of construction due to noise and related human activities.

Construction of the pipeline would have a limited effect on vegetation along the rest of the route. The most serious potential impact would involve the excavation of the pipeline trench along the northeast side of Carmel Street which may cut into the root systems of a row of ten to fifteen sweetgum trees located between the curb and the sidewalk. Because the severity of damage to trees depends on a variety of factors (such as the tree's inherent resistance to disturbance, the tree's susceptibility to disease and pests, and the actual number of roots that

are disrupted), the effects of the proposed project cannot be predicted with certainty. If any damage were to occur, it should be evident within one year of the initial disturbance. Although it would be difficult to restore the area to preexcavation conditions, Shell has made a commitment to replace damaged trees with comparable specimens.

No rare or endangered species have been identified on the proposed route nor is the proposed project expected to have any significant effect on them if they do exist somewhere in the project vicinity.

SOCIOECONOMIC CONSIDERATIONS

Socioeconomic effects of the proposed pipeline project are expected to be short-term and transitory, occurring only during the construction period. These impacts would be primarily related to the temporary disruption of normal pedestrian and vehicular mobility and access to homes, schools, and churches along the route. The disruption would generate some discomfort, irritation, and personal anxiety among some residents and drivers. These effects would be transitory, since each segment of the pipeline would be under construction for a limited amount of time, and the entire project would be completed within approximately 100 days.

Construction and operation of the proposed pipeline would cause no permanent changes in the socioeconomic character of the affected neighborhood. No housing units would be introduced or removed, nor is it likely the value of property along the route would change. No cultural or recreational facilities would be affected on a long-term basis.

The pipeline would be located beneath city streets. Therefore, the visual and aesthetic impact of the project would be limited to the construction period.

The construction of the pipeline would not place any significant demands upon public facilities and services such as water, sewer, gas, electricity, telephone, public transit, or schools.

Excavation of spoils from the ditch would amount to approximately 15,000 cu yds. It is expected that this material would be used for land fill and should not be a burden on solid waste disposal sites in the Oakland area.

TRANSPORTATION

The primary impact of the proposed pipeline would be the disruption of vehicular and pedestrian traffic. The disruption would occur only during construction, ceasing upon completion of the pipeline. Table 17 relates construction techniques to time and traffic. The segments in order of presentation are listed below (see Figure 6 for their location):

- Joaquin Miller Park
- Warren Freeway
- Monterey Boulevard
- Monterey Boulevard/Lincoln Avenue Intersection
- Lincoln Avenue
- Carmel Street
- Maple Avenue.

Joaquin Miller Park

Pipeline installation in this segment would employ oversized casing construction techniques (see Figure 17). Near the Palo Seco trailhead, a pit approximatley 10 ft x 12 ft x 9 ft would be excavated to accommodate an underground valve vault. The pipeline would follow an abandoned road now used exclusively by pedestrians for access to the Palo Seco Trail. Adjacent to the Mountain Boulevard entrance to Sequoia Lodge, a large pit approximately 40 ft x 15 ft x 15 ft would be excavated

Table 17. DATA RELATING CONSTRUCTION TECHNIQUES TO TIME, TRAFFIC, AND ALTERNATE ROUTES

Segment	Length of Construction Modes	Type of Disturbance	Traffic Lanes Open	Construction Rate			Alternate Route Desirable
				Progress/Day	Hr/Day	No. Days	
Joaquin Miller Park	Oversized Casing, Bore Pit 335 ft	Restricted access vehicles and pedestrians	0	120 ft	8	21	Yes
Warren Freeway	Bore Casing 192 ft	Unrestricted	All		Variable		No
Monterey Boulevard	90^{o} Bend 106 ft Oversized Casing 1143 ft	Restricted access vehicles and pedestrians	1	Variable	8	12	Yes
Monterey-Lincoln Intersection	Oversized Casing 1400 ft	Restricted access vehicles and pedestrians	1	120 ft	7*	14	Yes
Lincoln Avenue	Oversized Casing 2210 ft Conventional Burial 1500 ft	Restricted access vehicles and pedestrians	1	120 ft	7*	27	No**
Carmel Street	Oversized Casing 1100 ft Conventional Burial 1500 ft	Restricted access vehicles and pedestrians	1	120 ft	8	22	Yes
Maple Street	Oversized Casing 400 ft	Restricted access vehicles and pedestrians	1	120 ft	8	4	Yes

*Designated as a "limited operations area" by the City of Oakland. Seven hours is maximum time allowed for construction. No activities can take place before 9 a.m. and after 4 p.m.

**Alternate route desirable for oversized casing section in this segment.

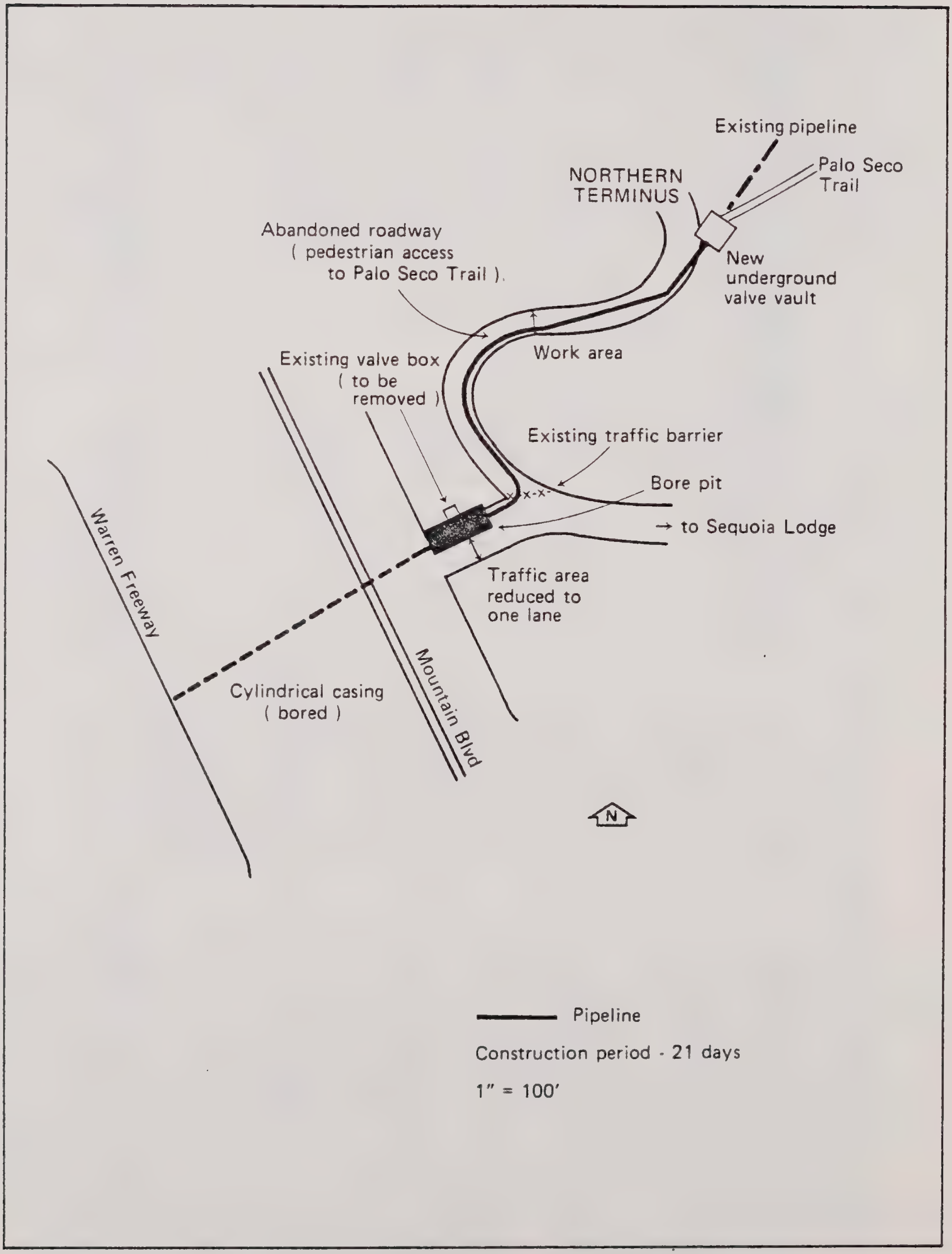


Figure 17. PIPELINE ALIGNMENT–JOAQUIN MILLER PARK

to accommodate equipment used in boring underneath the Warren Freeway. Construction in this segment would take a minimum of three weeks to complete.

Pedestrian access to the Palo Seco trailhead would be blocked during construction. Vehicular and pedestrian traffic using the Mountain Avenue entrance to Sequoia Lodge would be limited to one lane. Traffic would not be affected along Mountain Boulevard. Alternate access may be required for Sequoia Lodge.

Warren Freeway

The 54-in. cylindrical pipe casing would be bored under the Warren Freeway. Traffic would not be affected on the Warren Freeway.

Monterey Boulevard

Pipeline installation along Monterey Boulevard would employ oversized casing construction techniques for its entire length of 1273 ft (see Figure 18). Where the Warren Freeway pipeline casing intersects the Monterey Boulevard pipeline alignment, a large pit approximately 35 ft x 27 ft x 8 ft would be excavated to accommodate three 90^{o} bends designed to permit some pipeline flex in the Hayward fault zone. It would take a minimum of 7 days to construct the pipeline and 5 days to install the bends.

Vehicular traffic would be limited to one lane during the installation of the bends and pipe-laying operations. Pedestrian traffic should not be affected. Of particular importance here would be the resulting disruption of traffic using the Monterey Boulevard exit from the Warren Freeway and disruption of scheduling along AC Transit route "18".

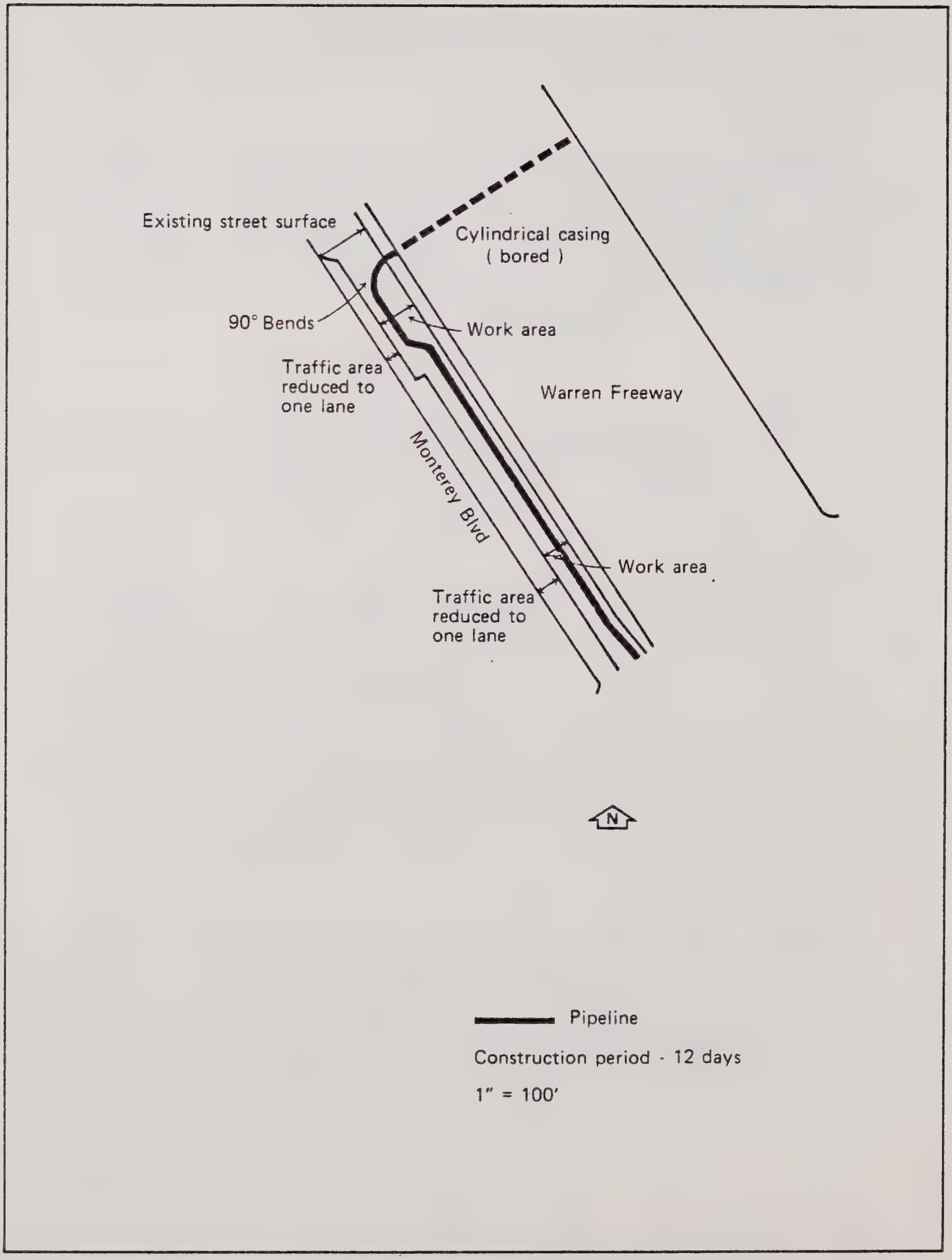


Figure 18. PIPELINE ALIGNMENT—MONTEREY BOULEVARD

Monterey Boulevard/Lincoln Avenue Intersection

Pipeline installation through the intersection would employ oversized casing construction techniques for its entire length of about 1400 ft (see Figure 19). It would take about two weeks to complete the intersection crossing.

Vehicular traffic would be limited to one lane for most of the period, and pedestrians would lose free access to the crosswalks. AC Transit buses serving routes "15a" and "18" would be affected, posing the possibility of a temporary scheduling change or rerouting. Vehicle and pedestrian access to public institutions, private institutions, and homes near the intersection would be hindered. Access to side streets would be altered for short periods.

Lincoln Avenue

Pipeline installation along Lincoln Avenue would employ oversized casing construction techniques for 2210 ft and conventional burial techniques for 1190 ft (see Figure 20). It would take about 27 days to complete construction.

Pedestrian traffic would be hindered crossing Lincoln Avenue, but should not be affected parallel to the street. Vehicular traffic would be limited to one lane near the construction activity. Access to driveways and side streets would be affected for short periods. AC Transit buses serving routes "15a" and "18" would be affected as would school buses serving Royce-Head School.

Carmel Street

Pipeline installation would employ conventional burial construction techniques between Lincoln Avenue and Coolidge Avenue, a distance of 1500 ft. Casing would be used between Coolidge Avenue and Maple Avenue, a distance of 1100 ft (see Figure 21). It would take about 22 days to complete construction.

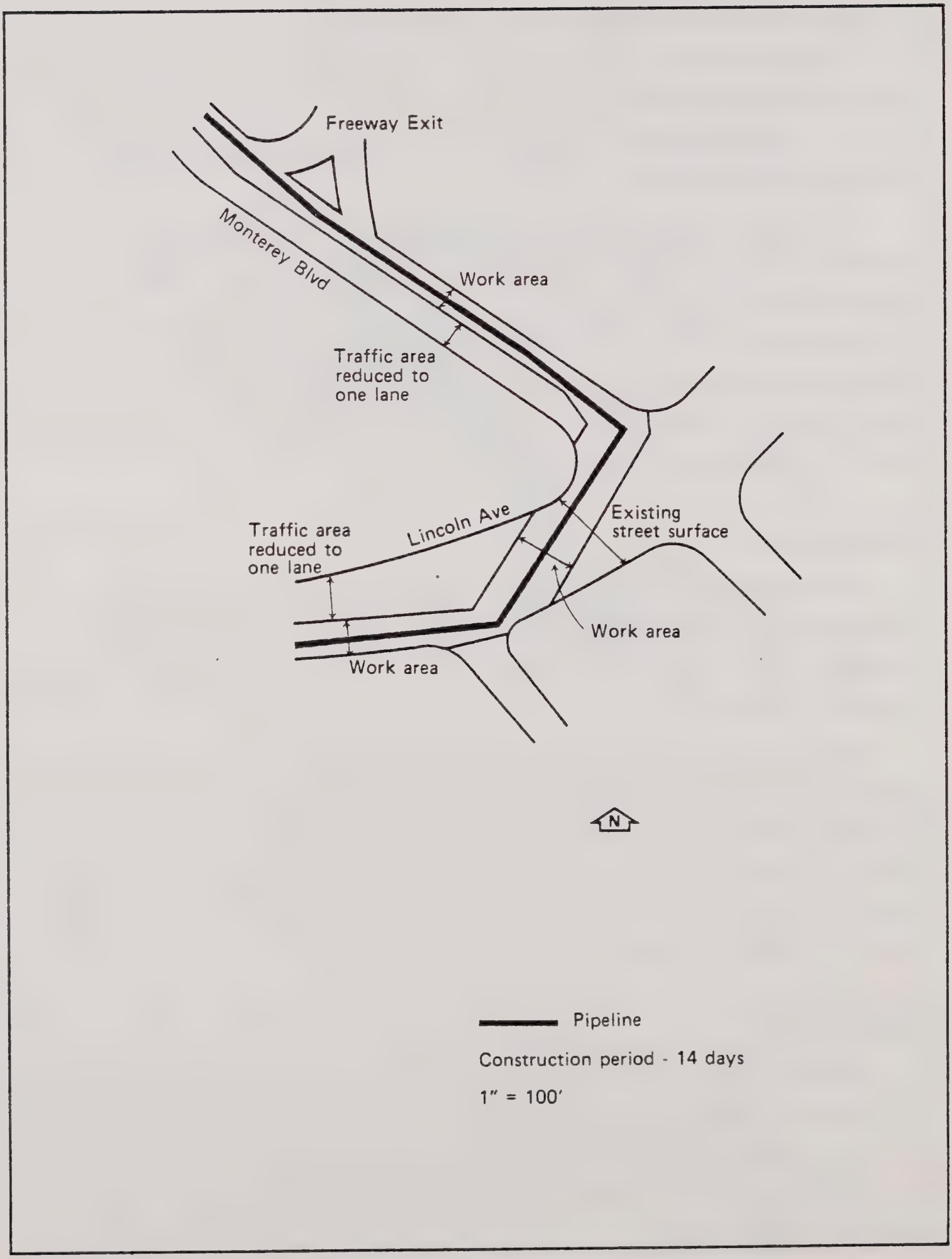


Figure 19. PIPELINE ALIGNMENT—MONTEREY BOULEVARD/LINCOLN AVENUE INTERSECTION

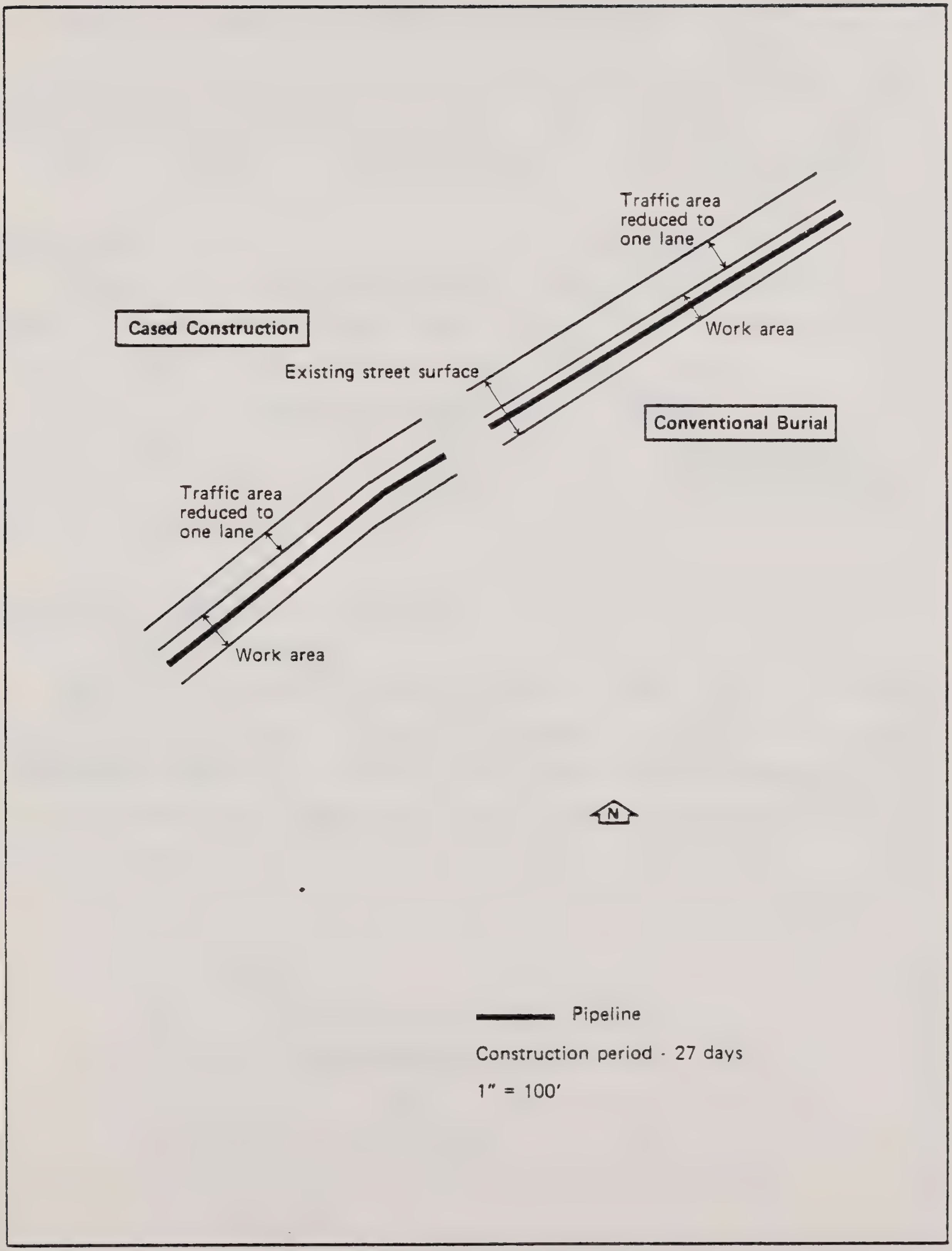


Figure 20. PIPELINE ALIGNMENT—LINCOLN AVENUE

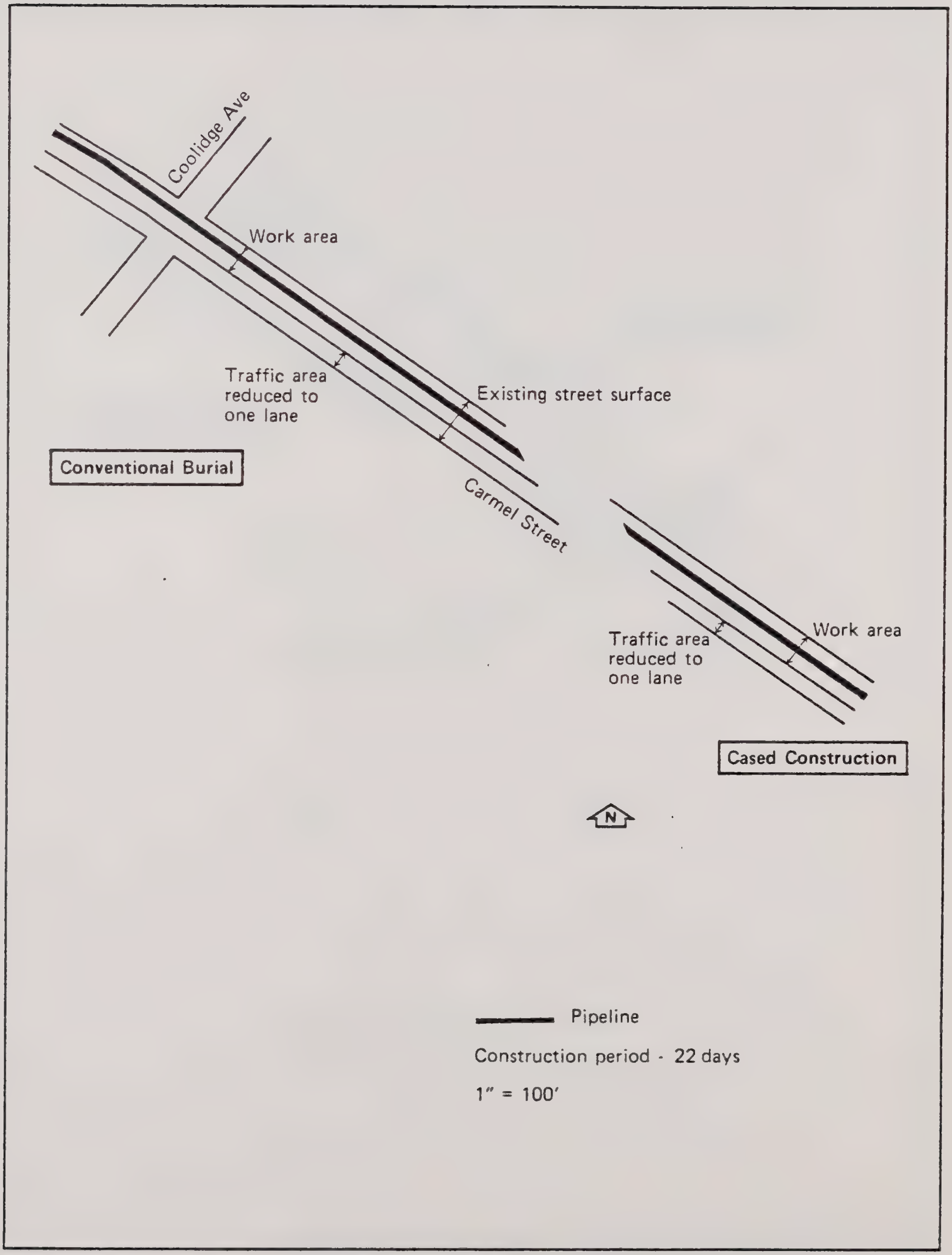


Figure 21. PIPELINE ALIGNMENT—CARMEL STREET

Vehicular traffic would be limited to one lane throughout the segment and may be completely blocked between Coolidge and Maple avenues. Access to driveways would be hindered. Pedestrian traffic would be detoured, restricted, or blocked for short periods at street crossings.

Maple Avenue

Pipeline installation would employ casing techniques for the entire length of line on Maple Avenue, about 400 ft. It would take about 4 days to complete construction (see Figure 22).

Vehicular and pedestrian traffic would be affected only slightly. Vehicular traffic would be limited to one lane in the construction zone, and pedestrian traffic would be rerouted at the intersection of Carmel Street and Maple Avenue.

HISTORICAL/ARCHAEOLOGICAL RESOURCES

There are no known archaeological or historical sites of interest along the pipeline route. There is a potential, however, of some remains being discovered. The consulting archaeologist suggested that this could be mitigated by having the excavation monitored by an archaeologist (Appendix D).

Section V

UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS RESULTING FROM PROJECT

If the proposed pipeline project were constructed as planned, the following unavoidable short-term impacts are expected to occur during construction operations:

- Increased traffic congestion and inconvenience to pedestrians
- Disruption of habitat in limited areas
- Increase in noise levels
- Minor increase in air pollutant emissions.

These impacts are discussed in the following paragraphs.

TRAFFIC

Adverse impacts to vehicular and pedestrian traffic would be an unavoidable consequence of pipeline construction. As construction progresses, "bottle-necks" will occur and would affect traffic in the immediate vicinity. Congestion would be critical during the peak traffic periods between 7-9 a.m. and 4-6 p.m., particularly on Lincoln Avenue and at its intersection with Monterey Boulevard.

BIOLOGY

Unavoidable adverse impacts would include the removal of a few California blackberry shrubs. Habitat would be disturbed in Joaquin Miller Park. However, construction of the pipeline should not cause

any long-term impacts to wildlife in the park. Construction of the pipeline along Carmel Street will have some effects on the sweetgum trees located there. No adverse impacts on rare or endangered species are anticipated.

NOISE

Construction activities would temporarily increase background noise levels in the project vicinity to levels as high as 93 dBA. Residents along the proposed pipeline route would be most affected. Annoying noise levels would occur only during the workdays and would be localized.

AIR QUALITY

Unavoidable adverse air quality impacts would occur during the period of construction. The operation of construction equipment and increased vehicular traffic congestion would result in increased emissions of CO and NO_2. Onsite particulate concentration could become a possible nuisance to residences in the immediate vicinity of the construction site. The proposed project would be responsible for a minor increase in the quantities of local air pollutants emitted during the workday, but these would not adversely affect regional ambient air quality.

Section VI

MITIGATING MEASURES

The following paragraphs discuss measures which would be taken to mitigate adverse environmental impacts and conserve energy. The applicant, Shell Oil Company, has noted that the project has been designed with the intention of avoiding or minimizing adverse impacts.

TRAFFIC

Detailed descriptions of the traffic controls and authorization procedures applicable to the proposed project can be found in *Manual for Construction Traffic Control,* distributed by the City of Oakland's Office of Public Works. The more relevant provisions are summarized below.

Before any street closures can occur, authorization must be obtained from the City of Oakland's Engineer and the Oakland Traffic Committee. Their authorization is contingent upon proper traffic controls. The work area must be kept to a minimum, but large enough to permit proper construction techniques. Temporary roadways and walkways must be provided where the permanent traffic paths are closed or disrupted. Access must be provided to all service facilities, including walkways separated from traffic and construction operations. All intersections must have open traffic lanes, and pedestrian crossings must occur at intervals of not more than 300 ft. The intersection of Monterey Boulevard and Lincoln Avenue, and all of Lincoln Avenue are designated as "Limited Operations Areas." No construction activity may take place

before 9 a.m. or after 4 p.m. Where it is necessary to bridge excavations, the riding surface must permit vehicles to proceed at normal speed.

Warning and directional devices such as cones, barricades, signs, and flagmen would be placed near and around the construction area. The use of traffic controls would permit a continual and orderly flow of vehicles and pedestrians. Where construction activities interfere with commuter and school buses, provisions must be made for their passage.

The bore pit excavated at the Mountain Boulevard entrance to Sequoia Lodge should not block vehicular and pedestrian access. The pit would be shored rather than sloped, permitting a narrower excavation. On the west side of the Warren Freeway, the installation of fabricated pipe bends in the pipeline may close Mountain Avenue for a period of time. This closure would not permit the AC Transit Company to maintain their bus route "18". They must be notified 15 to 30 days in advance of the anticipated closure to allow them to select an alternate bus route.

BIOLOGY

The destruction and disruption of habitat in Joaquin Miller Park would be minor. Indigenous plant species injured or destroyed by construction would be replaced. A well-designed replanting program and natural succession would assure successful revegetation of disrupted plant communities and the restoration of wildlife habitat.

WATER QUALITY

The only anticipated impact on water quality is the introduction of sediments to surface runoff water. To reduce the amount of erosion and resulting sedimentation, spoil would be kept to a minimum, and either removed or covered during rain. The construction plan (which

dictates that only a relatively short reach of trench is exposed at a time) would tend to control the effects of erosion and sedimentation on surface runoff water.

AIR QUALITY

Emissions due to construction-related activities would be local and temporary. Fugitive dust particles would be kept to a minimum by watering down dusty areas during construction. Reducing the handling of spoil and fill material would also help minimize the amount of fugitive dust. Proper traffic controls would reduce excessive exhaust emissions.

NOISE

All equipment would conform to local noise ordinances. Increased noise levels woud be of short duration and confined to daylight hours.

SEISMIC

The pipeline has been designed to compensate for vertical and horizontal displacement during a maximum probable earthquake of Richter magnitude 6.5 along the Hayward fault. Those sections of pipeline traversing potentially active fault zones are cased to protect them from shear movement.

USE OF ENERGY

Shell Oil Company is presently using a common-carrier pipeline owned and operated by the Southern Pacific Transportation Company (SP) to transport petroleum products previously transported through their own pipeline. The SP-owned facility is used to transport many

types of petroleum commodities for several customers. The pipeline is in operation for 24 hours per day, seven days per week. The amount of energy consumed in operating the SP pipeline changes with the amount of commodities it transports. A decrease in transported products would reduce the pumping rate of their common-carrier line. The reduction of energy consumed by SP should approximately equal the energy required to operate Shell's pipeline; thus, the total energy consumed will remain approximately the same.

Some energy would be consumed during construction. To minimize consumption, construction equipment should be efficiently used. Where appropriate, the same piece of equipment should perform multiple tasks.

PIPELINE SAFETY

As discussed in detail in Section II, the proposed pipeline design incorporates many measures to lessen the probability of product spillage. The proposed route was selected with geotechnical considerations as the primary criteria. The double casing design is intended to protect the pipeline from excessive stress during anticipated earthquake events and accidental damage through excavation. The relatively deep burial of the pipeline (4 ft minimum along the 2710 ft of conventional burial; 2 ft plus the casing plus the internal clear space of approximately 2 ft in the 6890 ft of cased pipeline) would give it additional protection from accidental damage through excavation. The fact that the route lies primarily beneath public streets also favors its integrity, since excavations therein are required to go through a rigorous permitting program which should signal presence of the pipeline. The elaborate and closely-spaced valves (13 valves between refinery and project, 12 of which are within 8 miles) are intended to provide control of flow under a broad range of normal and emergency operating conditions.

Both Shell and the City of Oakland (i.e., Fire Department, Fire Marshall, Public Works Department, and Planning Department) have carefully considered the possible effects of pipeline failure and courses of action (See Part B). Shell has developed an Oil Spill Contingency Plan (filed with the City of Oakland) which is intended to facilitate spill cleanup and hazard control. They are also affiliated with Clean Bay, a cooperative formed to control oil spills.

Section VII

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Benefits from the proposed project would include improved reliability of petroleum products delivery to the consumer and a franchise compensation (paid to the City of Oakland). Additionally, Shell would benefit by making use of a previous investment.

Costs would be in the form of environmental impacts (e.g., traffic and habitat disruption, erosion, air and water pollution, aesthetic impacts, noise) and an increased demand on city services. There would also be the creation of a long-term (albeit unlikely) risk to health, safety, property, and environmental values. Shell would incur the costs of the initial construction investment and operation and maintenance of the pipeline.

Section VIII

IRREVERSIBLE CHANGES AND RESOURCE COMMITMENTS

Construction of the proposed pipeline would cause no significant irreversible environmental changes. The entire pipeline route would be restored to its preconstruction condition.

Construction and operation of the proposed project would have only minor demands on natural resources or the services that use natural resources. Construction materials required would include such resources as: metal for the pipe arch, steel for the pipe and valves, concrete for pipe support and the different casings. Other resources consumed during construction include fill, sand, gravel, base rock, and asphalt. The proposed project would place a demand on manpower resources, fuel for operation of construction equipment, and small amounts of water for dust control and concrete removal. These materials and resources would be irretrievably committed during the construction phase. When completed, pipeline operation would consume energy to transport oil products.

Part of the proposed route passes through a pipeline corridor shared with other users (e.g., East Bay Municipal Utility District, Pacific Gas and Electric, Pacific Telephone, the City of Oakland). The introduction of the proposed pipeline in this established pipeline corridor would result in a greater intensity of a preexisting land use. The pipeline route franchise as well as the space the pipeline and its appurtenances occupies may be considered an irreversible change or at least a long-term commitment.

Because the proposed pipeline would be located in city streets and abandoned roadways, it would not affect mineral resources, open space buffers, or wildlife preserves.

Section IX

GROWTH-INDUCING EFFECTS

It is unlikely that the construction of this pipeline project would change the character of the neighborhood. Although some residents are apt to disapprove of the pipeline route, it is assumed that it would not provoke them to actually move. Therefore, the stability of the neighborhood is not likely to be affected by construction of the pipeline.

Although the completed pipeline would contribute to the regional economy, it would provide no incentive for growth in the neighborhood. Upon completion, the pipeline would restore Shell Oil Company's Bay Area Products Pipeline to its pre-London Road slide condition and use. The project would provide some short-term contribution to construction employment and the use of materials and equipment which would provide a minor economic gain, however this would not be sufficient to sustain a growth of the construction industry.

Section X

ALTERNATIVES TO THE PROPOSED PROJECT

Several alternatives were considered prior to the decision to restore the Bay Area Products Pipeline: continued use of the present system, alternate modes of transportation, and alternate routes. These alternatives are discussed in the following paragraphs.

NO ACTION — CONTINUED USE OF PRESENT SYSTEM

Shell Oil Company is presently transporting petroleum products through a 35-mile system composed of two separate pipelines; one is used exclusively by Shell and the other is a common carrier-pipeline owned and operated by Southern Pacific Transportation Company. Although the system has allowed Shell to meet its customers' demands, there are disadvantages.

Shell has drawn attention to the fact that scheduling problems may arise in using the common-carrier pipeline, causing delays in fueling operations at Oakland International Airport. A failure of the common-carrier system could significantly effect operations at San Francisco International Airport and San Jose Municipal Airport in addition to Oakland International Airport. Products terminals served by the pipeline could also be forced to cut back operations.

Continued use of the present system would mean that the investment Shell Oil Company made in constructing their Bay Area Products Pipeline would not be realized. Eighteen miles of 10 in. pipeline are now idle.

Shell customers are subject to delays in delivery and somewhat higher transport costs. On the other hand there is no risk of accident along the idle portion.

ALTERNATIVE MODES OF TRANSPORTATION

Shell has conducted cost and safety comparisons for four different modes of transporting oil products: motor truck, rail car, barge, and pipeline. Comparisons of cost and safety per ton-mile of products shipped are presented for each mode of transportation in Table 18.

Table 18. COST AND SAFETY COMPARISON AMONG VARIOUS OIL TRANSPORTATION MODES

	Motor Truck	Rail Car	Barge	Pipeline
Cost per ton-mile in mils	80	16	3	3
Transportation-related fatalities per billion ton-miles for the years 1963-1968	10.9	2.5	0.31	0.011

An examination of comparative costs of transporting petroleum commodities shows that barge and pipeline transport are the lowest. Since overall cost of transport is directly related to the distance the commodity is transported, the shortest route is the most economical. The proposed pipeline would be a shorter and thus a more economical transport mode than a barge route or the present common-carrier pipeline.

Although comparative data between the transportation modes are scarce, statistics on transportation-related fatalities for each mode from 1963 through 1968 indicates that pipelines are by far the safest method of transporting petroleum products.

Statistical records indicate that pipelines are also the most common means of transporting petroleum commodities in the United States. The Interstate Commerce Commission reported that in 1975 9.1 billion barrels of petroleum products were transported by 220,000 miles of pipelines of all diameters, ages, and conditions. During the same year the Department of Transportation (DOT), Office of Pipeline Safety (OPS) recorded spill losses totalling 293,643 barrels. These data indicate that about 1.33 barrels were spilled per mile of pipeline.

The restoration of Shell Oil Company's Bay Area Products Pipeline was deemed the safest, most economical, and most reliable means of transporting oil products. Barge transport was eliminated from further consideration for several reasons. Shell must transport about 35,000 bbl of products daily in their system. The largest barge able to negotiate the Oakland Inner Harbor Channel has a capacity of 24,000 bbls. This means that about 1.45 trips would be required daily. Also marine facilities would have to be constructed as well as a new pipeline joining the marine facilities to the remainder of the pipeline system.

Rail car and motor truck transport were eliminated primarily due to high costs and high risk factors. In addition, their use would involve the construction of terminals and tie-overs to incorporate each into the remainder of the pipeline system.

ALTERNATIVE PIPELINE ROUTES

Shell Oil Company engaged Woodward-Lundgren and Associates to examine alternative pipeline routes in 1969, prior to the slide disrupting service in the London Road pipeline. Five routes were investigated; the results of the investigations are summarized below. Figure 23 shows the five alternate routes and the existing route.

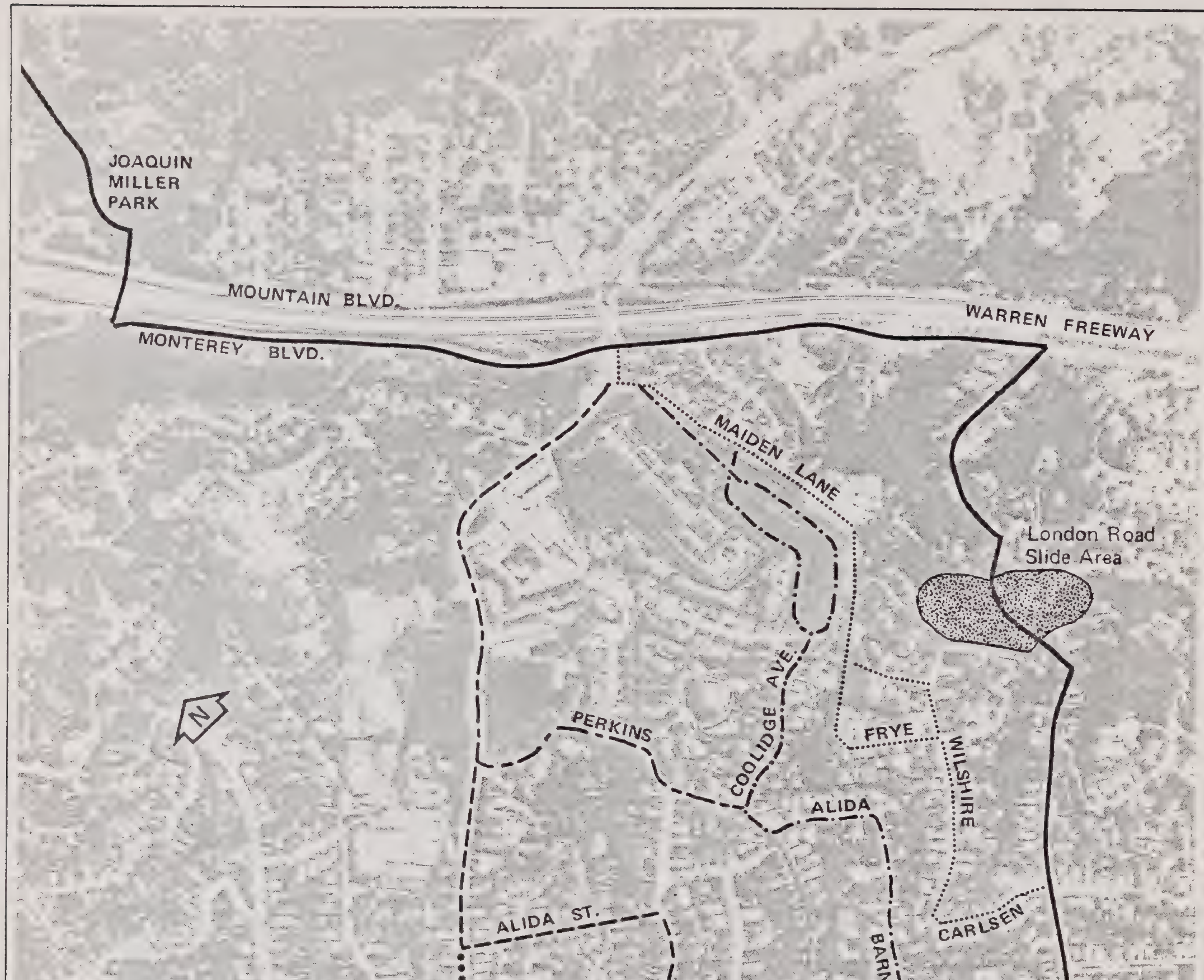


Figure 23. EXISTING AND ALTERNATIVE PIPELINE ROUTES

Route 1 - Wilshire Boulevard

The first portion of this route along Maiden Lane, including a section of buttress fill along the base of London Road, was considered stable. The route would have ascended a relatively steep slope of rhyolite at the southern edge of the fill and would have joined a topographic swale at the top of the slope. This steep slope has questionable stability since it is between the 1962 London Road slide and the slide which rendered the Shell pipeline inoperable in 1970. The entire west side of the creek near London Road was considered unstable due to its proximity to the Hayward fault and its composition of sheared serpentine, a weak rock commonly associated with landslides. Further evidence of instability was revealed by cracks in some concrete driveways in the area.

An alternate route was investigated that would have avoided unstable areas on Steinmetz Way by continuing down the creek and joining the alternative route at Frye Street. However, this portion also showed evidence of substantial soil creep, displaced concrete sidewalk and driveway slabs, and numerous cracks in the paved roads, and was abandoned. Wilshire Boulevard between Frye Street and Carlsen Street was considered unstable, as it lay just north of a steep 40 ft cliff facing Maple Street.

Route 2 - Coolidge Avenue

Geologically, Route 2 has no discernible adverse characteristics. The portion of the route between Maiden Lane and the Mormon Temple parking area would have ascended a natural slope underlain by rhyolite and would have crossed the Hayward fault at right angles, a desirable orientation in the event of slow creep or active faulting. The route within the parking lot would have been placed at the base of a large cut to avoid sections of the parking area situated on fill.

The original proposed route, following the Mormon Temple entrance drive and the downhill edge of the parking area, was not recommended because it would have been primarily situated on fill. The remainder of the route would have followed Alida, Barner, and Morgan avenues, all paved streets situated on a gently sloping hill. No evidence of instability was noticed in this portion of the route.

<u>Route 3 - Lincoln Avenue and Perkins Lane</u>

Routes 3 and 4 would have shared the same section of Lincoln Avenue between the Warren Freeway and Perkins Lane. Lincoln Avenue was carefully examined for cracks in its concrete surface that would suggest instability, and none were found. This portion of Lincoln Avenue appeared to be underlain at a shallow depth by sound rock, largely sandstone, shale, and small areas of rhyolite. A steep slope exists along the north side of Lincoln in this section, but appeared to be stable. Perkins Lane, as well as the remainder of the route on Charleston, Coolidge, Alida, Barner, and Morgan avenues showed no evidence of instability.

<u>Route 4 - Lincoln Avenue and Alida Avenue</u>

This route would have extended from the Warren Freeway down Lincoln Avenue, along Alida, Laguna, and Carmel, to Maple Avenue. The portion of this route that is different from Route 3, the lower portion of Lincoln, Alida, Laguna, and Carmel, showed no evidence of instability.

<u>Route 5 - Lincoln Avenue and Carmel Street</u>

This route is an extension of Routes 3 and 4. Lincoln Avenue was investigated and considered stable. It is underlain by competent sandstone and small lenses of shale. The attitude of the beds and the bedding sequence suggests that serpentine would not present a problem. One drill hole reached a depth of 58 ft and encountered only firm

sandstone. Based on the stability analysis of the slope, the results of the refraction seismic work, and detailed geologic study of the area, the following conclusions regarding the Lincoln Avenue route were made:

- The entire Lincoln Avenue route is underlain by competent rock.
- The rock is predominantly sandstone with minor shale.
- The sandstone and shale are uniformly, moderately weathered and firm near the surface and become fresh and hard at depths ranging from 15 to 30 ft below the roadway.
- These rock types are distinctly different from the rhyolite and highly sheared serpentine present in the London Road slide area.
- Where the slope below Lincoln Avenue is steepest, some shallow slides may occur in the future within the highly weathered rock near the outer edge of the roadway. However, the inside of the roadway is underlain by competent rock and is stable.

The Lincoln Avenue and Carmel Street route was chosen because it would be most stable. Construction would be facilitated by the width of Lincoln Avenue, and the short portion proceeding down Carmel Street would cause less disruption to local residents than Routes 1 through 4.

The presence of the Hayward fault was not a factor in selecting one route over another, since all potential routes must cross the fault zone. They would all face the same hazard from either slow fault creep or rapid fault movement during an earthquake. During construction, the route would be carefully observed in the fault zone to determine the exact location of the fault. This would determine the area of possible future movement of the pipeline and allow monitoring of any movement.

PART B

DISCUSSION OF POSSIBLE PIPELINE ACCIDENTS

Section I

INTRODUCTION

Part A of this report covers information typical of most Environmental Impact Reports. However, because public concern may raise the issue of potential* threats to public safety and property, Part B has been included. The discussion here covers the potential cause of accidents, the magnitude of the resultant spills, the routes the spilled products would follow, the consequences of such spills, and the anticipated response to such accidents. The reviewer is encouraged to consider the information presented here along with that in Part A (Section II and Section VI).

*The term "potential threats" warrants some explanation. Although there is an almost limitless array of accidents which could conceivably damage the pipeline, given that one uses enough imagination, we have limited our focus here to a narrower range of accidents which appear to be rather plausible. These would include such occurrences as seismic damage, landslides, rupture by excavation projects, corrosion, defective workmanship or materials, and intentional destructive acts (e.g., sabotage, vandalism).

Section II

CAUSES OF ACCIDENTS

Pipelines tend to be a comparatively safe and reliable means of transporting bulk materials. However, since the proposed pipeline would transport flammable petroleum products through a populated area, it is important to consider the ways accidents could occur. The discussion begins with a review of national-scale operating statistics.

Pipelines are the most common means of transporting petroleum commodities in the United States. The Interstate Commerce Commission reported that in 1975 9.1 billion barrels of petroleum products were transported by 220,000 miles of pipelines of all diameters, ages, and conditions. During the same year the Department of Transportation (DOT), Office of Pipeline Safety (OPS) recorded spill losses totalling 293,643 barrels. These figures include spills of all types of petroleum products. These data indicate that about 1.33 barrels were spilled per mile of pipeline in 1974, about .003 of one percent of total volume transported. For 1974, the OPS recorded 256 accidents which led to an oil loss, an average of 0.00116 spill accidents per mile of pipeline. Examination of similar statistics (U.S. Department of Commerce, 1974, Department of Transportation 1969-1975) shows that the above statistics are typical of recent years. Such statistics suggest that the likelihood of significant spillage is quite low.

Table 1 presents data for all reported petroleum product pipeline spill events in 1974 and reports causes, volumes lost, and the age of the pipeline at the time of the event. These data show that excavation

Table 1. SUMMARY OF LIQUID PIPELINE SPILL EVENTS IN 1976.

Cause	Number	Percent of Total	Loss of Commodity (barrels)	Number of Events by Year of Installation							
				Before 1920	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1976	Not Reported
Equipment Rupturing Line	67	32.0	74,590	2	7	7	16	21	11	3	0
Corrosion — External	41	19.6	31,954	5	6	8	9	7	3	1	2
Incorrect Operation by Carrier Personnel	20	9.6	40,155	1	3	1	3	3	6	3	0
Defective Pipe Seam	14	6.7	38,494	0	0	0	3	5	6	0	0
Corrosion — Internal	10	4.8	3,249	2	0	3	2	1	1	0	1
Failure of Previously Damaged Pipe	7	3.3	20,070	0	0	0	1	4	2	0	0
Malfunction of Control or Relief Equipment	1	0.5	235	0	0	0	1	0	0	0	0
Defective Girth Weld	4	1.9	13,025	0	2	1	0	0	1	0	0
Vandalism	3	1.4	7,428	0	0	1	0	0	2	0	0
Malfunction of Valve	4	1.9	2,521	0	0	1	2	0	0	1	0
Threads Stripped or Broken	2	1.0	328	0	0	0	1	0	0	1	0
Cold Weather	5	2.4	4,365	1	0	1	0	1	0	2	0
Pump or Appurtenance Facilities	5	2.4	1,550	0	0	1	1	0	2	1	0
Lightning	1	0.5	0	0	0	0	0	1	0	0	0
Tank or Appurtenance Facilities	5	2.4	1,560	0	0	0	1	1	1	1	1
Motor Vehicle	1	0.5	499	0	0	0	0	1	0	0	0
Miscellaneous	19	9.1	15,014	0	0	3	2	3	6	3	2
Total	209	100.0	255,037	11	18	27	42	48	41	16	6

Source: DOT, Office of Pipeline Safety Operations, *Summary of Liquid Pipeline Accidents* (May 1977).

equipment operated by others was the most frequent cause of loss and was also responsible for the highest volume loss. The next most frequent cause of loss was external corrosion. The next was defective pipe seams.

It should be noted that the data contained in the table include all pipelines, regardless of size, age and condition, which transport petroleum products. These figures indicate that the losses due to the structural integrity of the pipe and its ability to withstand external forces (e.g., external corrosion, defective pipe seams, internal corrosion) have generally decreased in frequency with newer pipelines. This reduction may be attributed to three primary factors:

- newer pipelines tend to have higher integrity
- materials and quality control used in the manufacture of pipe have improved significantly; and
- methods of construction have improved.

Given the broad scope of available data and the difficulty in assigning causes of spills to various pipeline designs, sizes, and operating parameters, it would be misleading to assign definite probabilities of occurrence of any of the listed causes to a specific pipeline. However, it is anticipated that those causes related to pipeline construction are likely to continue to decrease as more technical advances are made and as older lines are replaced by new ones. Considerable research has gone into the development of higher grade steels for pipeline construction. The construction of pipelines and their appurtenances have also gone through a rapid improvement stage. Welding and testing procedures have improved significantly. Welds on high pressure systems are X-rayed as required by pipeline codes to ensure a high-quality weld, and pipelines are hydrostatically tested to at least 1.25 times the design operating pressures.

The proposed relocated pipeline would include a variety of precautionary measures by Shell to avoid a spill and to protect against the recognized source of occurrences causing spills. Precautions that would be taken to minimize third party accidents include:

- the utilization of the highest grade steel and welded joints in the pipeline
- protecting 72% of the pipeline with casing conduits (either reinforced concrete box type, steel pipe casing or corrugated metal type conduit, depending on location) which would surround the pipeline to provide a dead space between the casing and the pipe
- locating the pipeline underground with a minimum of 4 feet of cover over the 10-inch carrier pipe and 3 feet of cover over the casing
- specifically designating its location on engineering maps filed with the City to be used by the City in notifying third parties granted excavation permits in the vicinity of the pipeline.

The second most frequent cause of accident (external corrosion) would be avoided by cathodic protection of the line. This system would be monitored continuously to detect any drop in the impressed voltage of the system and facilitated correction. As the pipeline would not transport corrosive substances, internal corrosion would be insignificant. The third most frequent cause of accident (i.e., defects in the seams of the pipeline) would be avoided by the use of seamless pipel. In addition, 100% of the welded joints will be x-rayed.

Section III

MAGNITUDE OF POTENTIAL SPILLS

The volume of petroleum product which would be released during a spill incident depends upon three factors:

1. The volume of product which would be pumped during the response interval (i.e., between the time the spillage begins and the time pumping stops and major valves close). This volume can be computed on the basis of flow rate and time.
2. The volume of product which would surge out of the pipe by momentum effects, even though pumping has ceased.
3. The volume of product which would drain out of the pipe by gravity. This volume can be computed on the basis of the length of pipe which drains freely and the pipe diameter.

The volume of product corresponding to the first item above could be as high as the maximum flow rate (3200 barrels per hour) times the length of time it would take to detect the spillage and stop the pump and/or close major system valves. For example, if it took 10 seconds to stop the pumping, 373 gallons could be pumped out; if it took one minute, up to 2240 gallons could be pumped out. Note that this assumes that the leak would be large enough to allow the full operating flow rate to be discharged. Obviously, a small leak would discharge a fraction of this maximum volume. The rate of response to a large leak would probably be on the order of tens of seconds to a few minutes, during which the leak would be detected and the pump(s) stopped and/or the major valves closed. Shell has stated that the automatic valves are designed to close completely in 60 seconds (more rapid closure could cause harmful pressure surges). Small leaks would release product at a far lower rate and could be repaired relatively easily (compared with an actual pipe

break). The time required to note a small leak might be quite long because the automatic systems would have difficulty detecting the small pressure differentials which they would create. Therefore, leak detection would probably have to be by measuring product volume differentials or by direct observation (visually or by odor) of product which escaped to the ground surface. Shell has stated that the maximum probable undetected loss would be 400 to 800 gallons over a 2 to 3 hour time period. Dispatchers would detect such leaks based on loss/gain data from the flow meters used for inventorying product. Shell has provided the following description:

> "The time of discovery of a small leak will be on the order of 2 to 3 hours. The volumes of product in the pipeline are continuously monitored, and if less barrels arrive at the receiving facility than are injected at the transmitting point (after taking into account normal losses due to compression or evaporation) the dispatcher will be alerted to the possibility of a leak and the system will be shut down pending investigation. The maximum probable undetected loss will be 400 to 800 gallons over a two to three-hour time period. Small leaks are normally caused principally by internal or external corrosion of the pipeline, or defective pipe seams. As the pipeline will transport a non-corrosive liquid and will be cathodically protected there will not be a weakening of the pipeline due to corrosion, thus minimizing the probability of a small leak. The pipeline will be seamless and accordingly no leaks will occur as a result of defective pipeline seams."

The volume of product which could surge out of the pipe by momentum after pumping has ceased and the major valves have closed — (the second item above) would be very difficult to compute. It is assumed here that the volume associated with this mechanism is only a small fraction of the volume associated with the other two mechanisms, and that the types of impacts which would result from a leak would be essentially similar, whether this mechanism was included or not.

The volume of product which could drain out of the pipe by gravity (the third item above) depends upon the pipe diameter and the length

subject to simple drainage. This length would run from the leak location, uphill to the nearest valve or to the nearest significant peak*. The least adverse potential accident in this relocated section would be a break at the highest point (which is located near the intersection of Monterey Boulevard and Lincoln Avenue, at approximately survey station 1072). If it were assumed that the valve (at survey station 1048) would close, then virtually no product would spill by gravity (although some could spill via the pumping and momentum mechanisms described above). Far worse potential accidents would be complete pipe breaks at locations far downstream (and downhill) of valves. For example, an estimated 12,900 gallons could drain out at the intersection of Maple Avenue and California Street.

If the valve in Joaquin Miller Park somehow failed to close, much of the product upstream could also drain out. If all of the valves failed to seal the line, the total drainage could be as much as 43,000 gallons (at the intersection of Maple Avenue and California Street).**

Note that the total spillage at a given location would be the sum of the volume pumped before shutoff and the volume which drains by gravity. Table 2 summarizes the calculated spill volumes at selected locations along the proposed pipeline. These locations were selected to give a broad view of the magnitude of potential spills; it should not be inferred that these locations are particularly prone to damage or spill occurrence.

In summary, the volumes of product which could spill are considerable; the actual quantities depend upon where the accident occurs and how long it takes to detect it and respond.

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*The pipe contains about 4.08 gallons per foot of length.

**The 1.67 miles of pipeline extending from Sequoia Lodge to the top of the pass (near where Park Blvd. and Pinehurst Rd. meet Skyline Blvd.) contains about 36,000 gallons. This analysis recognizes that the upstream valves could conceivably fail to close as intended but does not not suggest that such an occurrence is likely (it is considered here in the interest of completeness).

Table 2. ESTIMATED POTENTIAL SPILL VOLUMES*

Location of Break or Leak (See Figure 1)	Survey Station	Drainage Volumes if All Valves Close as Intended (gal)	Potential Drainage Volumes if Upstream Valves Do Not Close** (gal)
A: Joaquin Miller Park (tie-in to existing system)	1048+00	3,200	34,400
B: Existing park valve near Warren Free-way crossing	1052+30	7,600	31,200
C: Monterey Blvd.	1063+00	3,000	24,300
D: Lincoln Ave., near entrance to Mormon Temple	1077+00	2,800	23,800
E: Lincoln Ave., upstream from valve	1092+65	9,100	30,000
F: Lincoln Ave., near unnamed fault trace	1102+00	3,900	34,000
G: Carmel St. at Coolidge Ave.	1129+08	14,300	44,300
H: Maple Ave. at California St. (tie-in to existing system)	1144+00	12,900	43,000

* Add to these drainage volumes the volumes which would spill during the time before the system could be shut down. The volumes can be estimated, based on pumping rates. The maximum pumping rate is reported to be 3,200 barrels per hour, which is equivalent to 37.3 gal/sec or 134,400 gal/hour. The average daily rate is reported to be 35,450 barrels per day which is equivalent to 17.2 gal/sec or 62,037 gal/hour.

** All valves are assumed to remain open. Product is assumed to be held up in the low areas of the line.

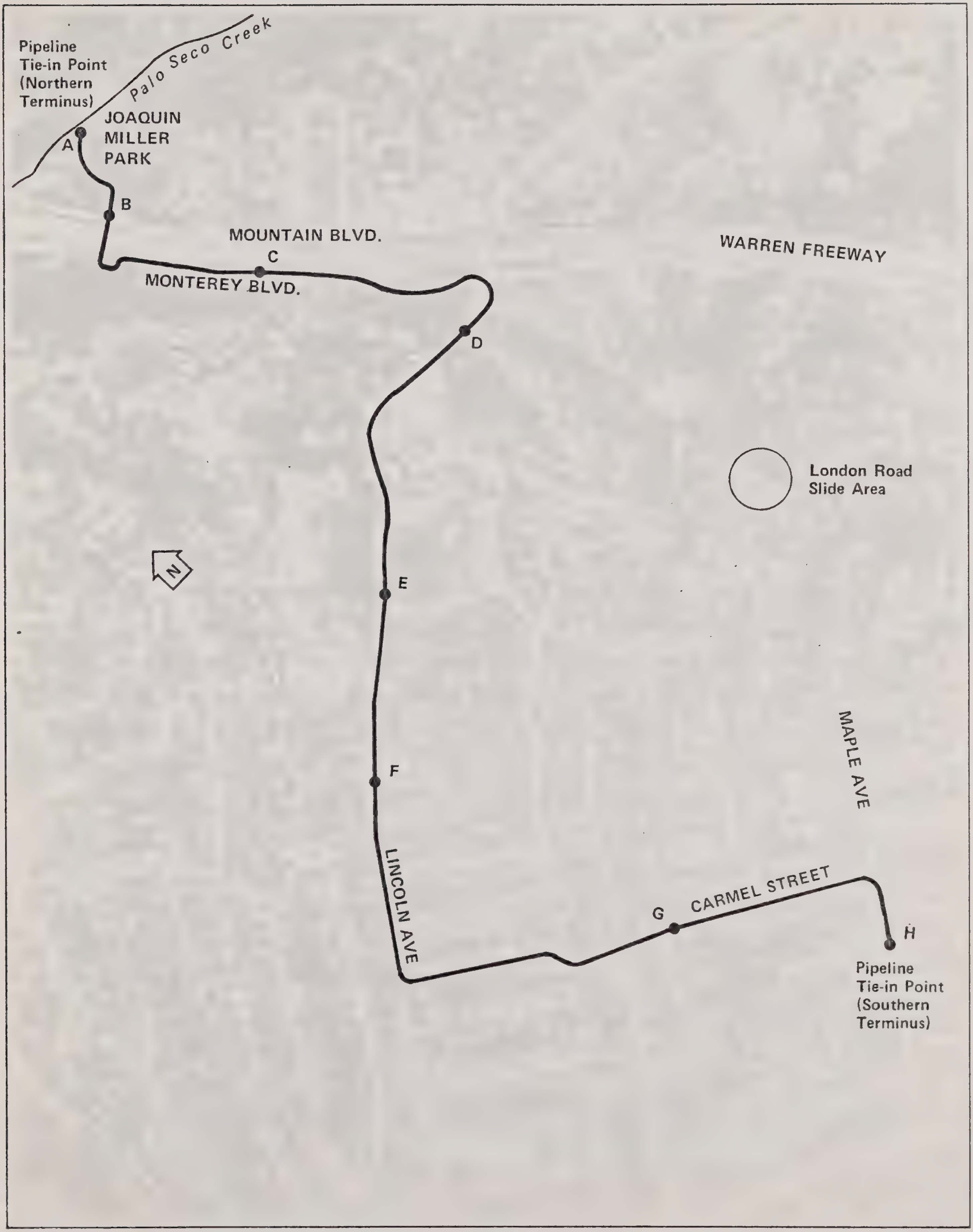

Figure 1. PIPELINE ALIGNMENT WITH SURVEY STATIONS

Section IV

ROUTE OF SPILLED PRODUCT

The route that spilled product would take would depend upon several factors, including:

- the location of the break or leak in the system
- the rate of spillage
- the topography, soils, ground cover, etc. in the downhill area

As noted previously, the volume of product which can spill is strongly dependent upon the size of the leak. Since there is no meaningful way to forecast leak size (much less how, when, or where one would occur), the consideration of spill consequences must proceed on a speculative, "what if . . . " basis. This involves postulating a series of plausible scenarios and estimating the hazards which might result if such hypothetical spills were to occur.*

Table 3 and Figure 2 summarize the courses that spills would probably take, given breaks or leaks at various locations along the proposed pipeline. It should not be inferred that these locations are particularly likely to experience failure; they were selected to cover a broad range of conditions which exist along the route. The table summarizes the spill courses under two sets of conditions:

- a break sufficiently large and sudden to assure the prompt, automatic closure of all major valves

*The current state of the art does not permit one to make meaningful forecasts of the probability of occurrence of these plausible scenarios.

Table 3. ROUTES OF SPILLED PRODUCTS

Location of Break or Leak (See Figure 1)		Survey Station	Route Description
A:	Joaquin Miller Park (tie-in to existing system)	1048+00	Spilled product would drain directly into Palo Seco Creek from the drain line near Survey Station 1048.
B:	Existing park valve near Warren Freeway crossing	1051+00	Spilled product would drain directly into Palo Seco Creek from the drain line near Survey Station 1048.
C:	Monterey Blvd.	1063+00	If the casing remained intact, the spilled product would flow out of the casing drain line near Survey Station 1054 and into Palo Seco Creek. If the product escaped the casing, it is possible that could leak out of the banks and onto the Warren Freeway or storm inlets. It would then cross the freeway via the storm drains and discharge into Palo Seco Creek.
D:	Lincoln Avenue, near entrance to Mormon Temple	1077+00	Spilled product would emerge in the landscaped border of the Greek Orthodox Church's parking lot on the south side of Lincoln Ave. It would flow through the parking lot and driveway and out onto Lincoln Ave. Some would enter the storm inlets.
E:	Lincoln Avenue, upstream from valve	1092+65	If the spill surfaced to street level, it would run down Lincoln Ave. and into the storm inlets. If the product seeped out of bank on the north side of of Lincoln Ave., it would drain through the campus of the Royce-Head School.
F:	Lincoln Ave., near unnamed fault trace	1102+00	If the spill surfaced to street level in the landscaped border, it would flow down Lincoln Ave. and Burlington St. Some of the product could cross Lincoln Ave. and flow into residential properties on the north side of the avenue. It would then probably flow down Fittin Rd. and enter the storm inlet at Tiffin and Whittle Ave.
G:	Carmel St. at Coolidge Ave.	1129+08	If the product surfaced to street level, it would flow down Coolidge Ave., entering storm drains, yards and probably drain across the schoolyard of Bret Harte Junior High School and into some nearby residences on MacArthur Blvd.
H:	Maple Ave. at California St. (tie-in to existing system)	1144+00	Surfaced spilled product would drain down Maple Ave. and then flow west down California and Madeline Streets where it would enter a number of storm inlets.

Note that all creeks ultimately enter the storm drainage system and all storm drains ultimately discharge into the Estuary.

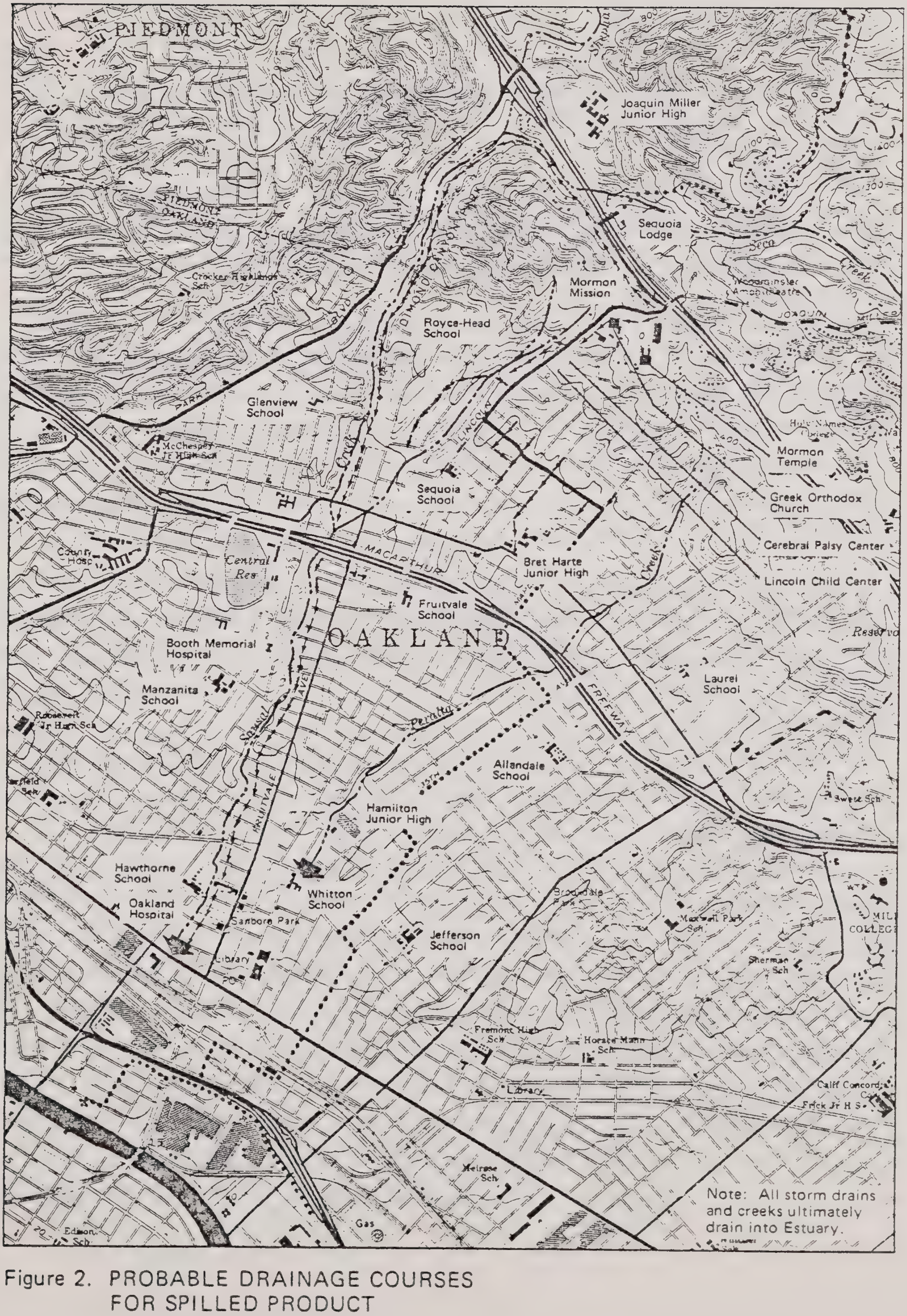

Figure 2. PROBABLE DRAINAGE COURSES
FOR SPILLED PRODUCT

- a smaller leak which requires on the order of an hour to detect and respond to (i.e., too small to trip the automatic valves).

The case of having a very small leak that takes a considerable time to detect is also plausible but is not discussed here, since the effects would be entirely speculative (depending entirely upon the conditions hypothesized).

Shell has pointed out that, in most instances, a substantial portion of the volume of a spill would never come to the surface because of containment by the casing surrounding the pipe, migratory collection in the manholes installed in connection with the pipeline, and the underground location of the pipeline which would result in lateral rather than vertical migration to the surface. If any of the spill were to reach the street surfaces it would be subject to containment and cleanup operations described in contingency plans of the Oakland Fire Department and Shell (which are designed to react promptly to any spill). To the extent surface flow occurred on other than city streets when the soil was wet, absorption would not be as great as with dry soil. If the soil were dry, the spillage would be absorbed by the ground within a comparatively short distance from the point at which the spill surfaced. If spillage should occur on wet soil, it might flow more readily, but the presence of water could provide some counterbalancing effects to reduce flammability.

Section V

EMERGENCY RESPONSES TO ACCIDENTS

Both the Oakland Fire Department and Shell Oil Company have carefully studied the proposed pipeline and its potential for accidental spillage and have made plans to minimize damage and threats to public safety. The following paragraphs summarize these plans.

FIRE DEPARTMENT RESPONSE

The Oakland Fire Department has gone on record stating that they believe that pipelines represent the safest method of transportation for large amounts of flammable liquids, but recognizes the need to consider the possibility of a major break occurring in the line and having a fire result. It has assessed the seriousness of such an event and have evaluated their ability to cope with the situation.

In responding to flammable liquid spills, the Fire Department assumes that the spill is going to ignite and burn. It makes this assumption because vapors from petroleum products such as gasoline, jet fuels, and diesel fuel are generally heavier than air, hug the ground, and can be easily ignited (depending on the availability of ignition sources). Fire fighting foam is used to successfully combat petroleum product fires. These foams are usually mixed with water and discharged through special nozzles to produce a foam blanket that is applied to the entire surface of the burning fuel. If quickly and properly applied, such blankets can control flammable liquid fires effectively. Limitations and problems associated with the use of foam include the following:

- The time required to respond to a fire and set up the foam streams is critical. Since petroleum product fires are quite hot, rapid application of large quantities of foam is mandatory for control. The Fire Department's capability to quickly apply large volumes of foam depends on the location of the incident. Since it is not practical for fire apparatus to carry large amounts of foam, additional supplies would have to come from Department storage areas in the event of a large spill.
- The entire surface of the burning liquid must be completely covered with foam to extinguish the fire or it will continue to burn. On a sloping surface, the flammable liquid can flow out from under the blanket and continue to burn.

The location of the proposed foam storage facilities in the Fire Department are as follows:

- Training Division - 250 Fallon Street
  #2 Engine - Foot of Broadway (fireboat)
- Headquarters Station - 1330 Grove St.
  #27 Engine - Hegenberger and Pardee Drive

Each of these locations currently has some storage of various types of foam. However, in the event that the pipeline was relocated and put in operation, the Fire Department plans to relocate foam supplies to firehouses adjacent to the pipeline.

Because flammable liquids are restricted from certain areas of the City, some engine companies have limited equipment to deal with this type of fire. If the pipeline were put back into operation, foam handling equipment would be placed on fire apparatus in the surrounding vicinity. In the event of a fire, the first and second alarm companies would have limited amounts of foam and thus there would be a need to dispatch other companies to nearby fire stations to pick up the foam and transport it to the fire scene. The Fire Department estimates a time of 15 to 20 minutes for this operation.

SHELL CONTINGENCY PLAN

Shell has prepared a product spill contingency plan which provides information on how spills can be dealt with. A copy is on file with the City and is available for inspection.

APPENDICES

Appendix A

REFERENCES

Alameda/Contra Costa Transit (AC Transit). July 1974. *AC Transit Bus Routes.*

Alquist-Priolo Geologic Hazards Zone Act (SB-520).

Bay Area Air Pollution Control District. 1972. *Meteorological and Construction Summaries.*

Bay Area Air Pollution Control District. August 22, 1973. *Technical Bulletin.*

Bechtel. 1973. "Volume I Pipeline Relocation and Design Through the Hayward Fault Zone for Shell Pipeline Corporation," *Final Report-Shell Bay Area Products Line.* Prepared by M.I. Al-Mutti. San Francisco, California. Bechtel Incorporated.

Brockman, C.F. 1968. *A Guide to Field Identification: Trees of North America.* New York: Golden Press.

Brown, V. and D. Hoover. 1967. *California Wildlife Map Book.* Healdsburg, California: Naturegraph Publishers.

Brown V., H. Weston, Jr., and Buzell, J. 1973. *Handbook of California Birds.* Healdsburg, California: Naturegraph Publishers.

Burt, W.H. and R.P. Grossenheider. 1964. *A Field Book to the Mammals.* Boston: Houghton Mifflin Company.

City of Oakland, Ordinance No. 8649: *An Ordinance Granting a Franchise to Shell OIl Company to Construct, Maintain, and Operate an Underground Pipeline for the Transportation of Refined Petroleum Products along, in, under, through, and over Public Places and Public Ways in the City of Oakland,* Sept. 1972.

City of Oakland. September 1973. *Manual for Construction Traffic Control.* Office of Public Works, Traffic Engineering and Parking Department.

Cooper Ornithological Club. March 29, 1927. *Directory to the Bird Life of San Francisco Bay Region.* Berkeley, California: J. Grinnell and M.W. Wythe.

County of Alameda, Office of Civil Defense, *Pipelines of Alameda County,* Jan. 1970.

Department of Transportation, Office of Pipeline Safety, *Summary of Liquid Pipeline Accidents,* 1974.

HUD Report No. TE/NA 142, December 1971. *Noise Assessment Guidelines Technical Background.*

Interstate Commerce Commission, *Transportation Reviews and Traffic of Large Pipeline Companies,* 1975.

Munz, P.A. 1959. *A California Flora.* Berkeley: University of California Press.

National Petroleum Council, February 1972. *Environmental Conservation.* Petroleum Advisory Council to the U.S. Department of the Interior and to the Office of Oil and Gas.

Offshore Development Engineering, Inc., *Design Review of Bay Area Products Line,* Jan. 1977.

Peterson, R.T. 1969. *A Field Guide to Western Birds.* Boston: Houghton Mifflin Company.

Smith, A.C. 1968. *Introduction to the Natural History of San Francisco Bay Region.* Berkeley: University of California Press.

Stebbins, R.C. 1966. *A Field Guide to Western Reptiles and Amphibians.* Boston: Houghton Mifflin Company.

Stebbins, R.C. *Reptiles and Amphibians of the San Francisco Bay Region.* Berkeley: University of California Press.

U.S. Department of Commerce. 1970. *1970 Census of Population and Housing; San Francisco-Oakland Standard Metropolitan Statistical Area.*

U.S. Department of Commerce. 1970. *Census Tract PHC (1) - 189.*

U.S. Environmental Protection Agency. 1971. *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances.*

U.S. Environmental Protection Agency. 1971. *Effects of Noise on Wilflife and Other Animals.* Prepared by Memphis State University (contract 68-04-0024). Washington, D.C.

U.S. Geological Survey. Topographical Map, 1:24,000. Oakland East Quadrangle.

Woodward-Clyde & Associates. June 5, 1970. *Shell Oil Bay Area Products Pipeline Detailed Engineering Geologic Investigation and Stability Evaluation - Lincoln Avenue Realignment - Oakland, California.* Oakland, California.

Woodward-Clyde & Associates. August 5, 1970. *Preliminary Evaluation of the Hayward Fault Zone, Shell Oil Products Pipeline, Oakland, California.* Oakland, California.

Woodward-Envicon, Inc., *Environmental Impact Report for the Eastside Flood Control Zone Project,* for Santa Clara County Flood Control and Water Conservation District, 1973.

Woodward-Envicon, Inc., *Environmental Impact Report for Air California Maintenance Facilities at Oakland Airport.*

Woodward-Lundgren & Associates. July 2, 1973. "Joáquin Miller Park to Maiden Lane, Oakland, California." *Geotechnical Evaluation of the Bay Area Products Pipeline Realignment (Phase I).*

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